RANGELAND ANALYSIS AND MANAGEMENT TRAINING GUIDE

ROCKY MOUNTAIN REGION
U.S. FOREST SERVICE

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To: Forest Supervisors

Rangelands are valuable and extensive ecosystems in the Rocky Mountain Region. They comprise about 50 percent of the Region's total land area. Rangelands provide clean water, forage for grazing and browsing animals, cover for many wildlife species, and a variety of recreational opportunities for our visitors. Rangelands are of vital economic importance to the many rural communities throughout our five state area.

As we continue our focus on ecosystem management, rangelands will play a critical role. I hope each of you will look at rangelands at a broader perspective, focusing on sustainable natural processes that provide healthy ecosystems for the needs and values of a diverse American public.

This Guide is an important first step in documenting the analysis and management processes for the future. There has been a tremendous amount of energy and expertise put into the development of this Guide from personnel within the Forest Service, other agencies, research, and western universities. I would like to thank all of those that contributed to this effort. The quality of the Guide is a testimony to the countless hours spent in producing it.

Elizabeth Estill

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REGIONAL FORESTER

Enclosure

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INTRODUCTION

Rangelands are a major component of ecosystems in the Rocky Mountains. They are lands that include strong representation by herbaceous and graminoid species. Rangelands include, but are not limited to: grasslands, forblands, shrublands, open-canopied forests, and associated riparian and aquatic areas. Well-managed rangelands provide forage and cover for wildlife and domestic livestock, in addition to high-quality water and numerous recreational values.

OBJECTIVES

Rangeland analysis is essential for planning Forest Service management activities. This Guide provides instructions and standards for conducting rangeland analysis in the Rocky Mountain Region of the Forest Service. Rangeland analysis information is used to prepare and maintain Forest Land and Resource Management Plans and project level plans (for example, Allotment Management Plans). Rangeland analysis uses a systematic procedure of collecting, recording, and evaluating data. It also provides permittees, Forest Officers, cooperating agencies, and the public an opportunity for mutual appraisal of rangelands. The intensity of studies made on rangelands will vary dependent on the need for information, and land management and allotment objectives.

DIRECTION

Instructions in this Guide are supported by direction and guidelines in other documents, including: the Forest Service Manual[1]; the Service-wide Range Analysis and Management Handbook[2]; the Ecosystem Classification, Interpretation, and Application Handbook[3]; and the Integrated Resource Inventory Training Guide[4]. Individuals performing rangeland analysis should be familiar with direction in these documents before starting an analysis project.

[1] FSM 2210 and FSM 2060
[2] FSH 2209.14
[3] FSH 2090.11
[4] Rocky Mountain Region

GENERAL INSTRUCTIONS

Rangeland analysis is concerned with the systematic collection and evaluation of rangeland resource data. Existing vegetation (plant community) and desired vegetation are mapped and inventoried. Within these map units, plant species, suitability for livestock grazing, and vegetation management status of the rangeland are identified. The analysis provides a baseline for determining resource value ratings, and it provides for periodic measurement of rangeland condition, leading to trend determinations.

The National Forest Management Act of 1976 and implementing regulations identify information requirements concerning National Forest System grazing resources. This information shall be collected through range analysis and allotment management planning. The requirements are:

1. Identify suitability and potential capability of National Forest System lands for producing forage for grazing animals and for providing habitat for management indicator species.

2. Determine and monitor status and trend of suitable rangelands.

3. Determine present and potential supply of forage for livestock and wild free-roaming horses and burros, and estimated capability of these lands to produce suitable food and cover for selected wildlife species.

4. Estimate forage use by grazing and browsing animals.

5. Identify lands in less than satisfactory condition and prescribe the appropriate action for their restoration.

6. Develop range management prescription alternatives which provide for the maintenance and evaluation of soil, water, and air quality resources. Give consideration to:

    a. grazing systems and facilities necessary to implement;

    b. land treatment and vegetation manipulation practices;

    c. evaluation of pest problems;

    d. possible conflict or beneficial interactions among livestock, wild free-roaming horses and burros, and wild animal populations, and methods to regulate them;

e. direction for rehabilitation of ranges in unsatisfactory condition; and

f. comparative cost efficiency of prescriptions.

Rangeland analysis will meet or exceed these information requirements. The one possible exception is with respect to wildlife species; see the Planning Chapter for threatened, endangered, and sensitive species (page 2-3). Those species and their habitat requirements should be identified and evaluated as an integral part of rangeland analysis and allotment management planning. Where habitat requirements of plant and animal species are not fully understood, rangeland managers should continue with project planning and implementation using the best information available from wildlife and botany specialists. Range plans should include schedules for completing surveys and research to provide an appropriate level of information on threatened, endangered, and sensitive (TES) species and habitat. Project plans can be modified as the additional information becomes available.

ECOLOGICAL CLASSIFICATION

An ecological classification is the integration of landform, topography, geology, soil, vegetation, climate, and other characteristics into products useful to managers.[5] Products include guides and other tools. The data obtained through rangeland inventory and analysis will supplement the analysis used to develop ecological type classifications.

GUIDES

An ecological guide presents quantitative and qualitative information on ecological classification taxa, for example, landtypes, plant associations, and community types. They may be related to either potential natural vegetation or to existing vegetation. Table 1-1 displays the hierarchical framework of ecological units for inventory and mapping of climatic, geologic, topographic, edaphic, and aquatic characteristics, as well as existing and potential vegetation communities.

[5]FSM 2060 and FSH 2090.11

The information found in ecological guides should include:

- climate,
- physiography,
- hydrology,
- geology,
- soil,
- vegetative community descriptions (seral and potential),
- ecological and successional relationships,
- resource value ratings, and
- management implications.

Table 1-1. NATIONAL HIERARCHY FRAMEWORK OF ECOLOGICAL UNITS
(October 29, 1993)

PLANNING AND ANALYSIS SCALE	ECOLOGICAL UNITS[6]	PURPOSE, OBJECTIVES, AND GENERAL USE	MAP SCALE RANGE	GENERAL SIZE RANGE
ECOREGION Global	Domain	Broad applicability for modeling and sampling. Strategic plan and assessment. International planning.	1:30,000,000 or smaller	1,000,000's of square miles
Continental	Division		1:30,000,000 to 1:7,500,000	100,000's of square miles
Regional	Province		1:15,000,000 to 1:5,000,000	10,000's of square miles
SUBREGION	Section	Strategic, multi-forest, statewide, and multi-agency analysis and assessment.	1:7,500,000 to 1:3,500,000	1,000's of square miles
	Subsection		1:3,500,000 to 1:250,000	low 1,000's to 10's of square miles
LANDSCAPE	Landtype Association	Forest or area-wide planning, and watershed analysis.	1:250,000 to 1:60,000	1,000's to 100's of acres
LAND UNIT	Landtype	Project and management area planning and analysis.	1:60,000 to 1:24,000	100's to 10's of acres
	Landtype Phase		1:24,000 or larger	<100 acres

[6]Terms are derived from Bailey's Ecoregions, 1983 (Domain, Division, and Province) and Wertz and Arnold, 1972 (Section, Subsection, Landtype Association, Landtype, and Landtype Phase).

SCORECARDS

Ecological scorecards are one of many possible tools which may be derived from an ecological classification. A scorecard is normally used to evaluate the status of a specific plant community, estimate resource value ratings, or estimate carrying capacity. The evaluation can be expressed in terms of ecological status (the seral stage or successional status of a particular plant community with respect to its potential natural vegetation), or vegetation management status (the similarity of the current plant community to the desired plant community as specified by the desired condition).

OTHER TOOLS

Various other tools may be developed from an ecological classification. Possibilities include old growth scorecards, riparian evaluation guides, and predictive models. Management needs and availability of information will govern their development.

INTEGRATED RESOURCE INVENTORY

Integrated Resource Inventory (IRI) is an integrated approach to resource inventory in the Rocky Mountain Region. IRI focuses on common water, land, and existing vegetation components. A process for developing inventory maps for these components is documented in IRI training guides. This process enables Forests to properly integrate specific resource information in preparation for an electronic environment (Geographic Information System). Project level inventories are designed to nest in the hierarchy established by IRI. Inventory data at the project level will supplement and validate or correct data from other inventory levels.

The primary objective of IRI is to mesh existing information, provide consistency in how and where lines are drawn, and develop a standardized Regional convention for labeling/naming polygons. Existing information is used wherever possible, integrated through interdisciplinary efforts as appropriate for each Forest. Since great variability exists in the quality of existing information, each Forest evaluates their own information based on IRI guidelines.

The primary focus of IRI is to delineate basic resource related map units (polygons, lines, and points) to support decisions related to Forest and project planning. Integrated resource information will support the legal framework (NEPA, NFMA, and Forest Plans) within which we must operate. Standards will allow this information to be reliably aggregated upward to address planning, ecosystem management, and landscape ecology issues across administrative boundaries.

RESOURCE MAP LAYERS

Resource information will be grouped into three map layers: common water units, common land units, and common vegetation units. All three layers are dependent on each other and will be developed in conjunction.

Common Water Unit (CWU)

This map layer consists of watersheds, stream networks, lakes, reservoirs, ponds, springs, and seeps. The CWU stratification is hierarchical consisting of four spatially integrated biological, hydrological, and geomorphologic levels: watershed, valley segment, stream reach, and channel unit.

Common Land Unit (CLU)

This map layer consists of polygons which integrate landform, geology, soil, and potential natural vegetation, and represents the "permanent" terrestrial environment.

Common Vegetation Unit (CVU)

This map layer consists of existing, or transitory, vegetation (both live and dead). CVU polygons are most often delineated as areas of vegetation possessing sufficient uniformity in regard to species, age, crown condition, layering, size, and density. The area represented by the CVU is generally homogeneous, and is based on physical, observable, and largely quantifiable features and attributes. This is the information most often measured by range analysis methods.

IRI PROCEDURES

IRI procedures include photo-interpretation with the prerequisite validation, and field survey and sampling. Validation of photo-interpretation is a broad process, encompassing many intensity levels. The intensities range from a brief field visit to confirm or reject photo-interpretations, to intensive field sampling which may go far beyond the original photo interpreted attributes. Consequently, there may not be a clear distinction between the two procedures.

Completion of each inventory step is based on information requirements. These requirements will vary across the landscape and by the intensity of management. The important point is that inventory will be conducted commensurate with information requirements and the level of management intensity planned.

Photo-Interpretation and Validation

IRI photo-interpretation is a procedure based primarily on 1:24,000 resource photography. Delineations of map unit are based on specific criteria for each of the three map layers (CWU, CLU, and CVU). All available information is used to assist in the photo-interpretation process. Each map layer is integrated with the others to identify coincident lines and to assist in further delineation as necessary. All Forest Service administered lands will be mapped with this procedure.

Rangeland mapping and inventory procedures will start with IRI products. If IRI maps are not available for the rangeland being analyzed, then IRI guidelines and procedures should be followed. This ensures that the effort expended on rangeland inventory will be compatible with products developed later by the Inventory Centers.

Field validation of the photo-interpretation is accomplished per standards specifically developed for the IRI. The full range of validation intensities may be utilized for validation of photo-interpretation within the Region, and even within a National Forest. Project level needs, available support information, resource availability, and other factors may influence the intensity of the validation effort. Other criteria such as confidence of the photo-interpretation, number of acres represented by a particular map unit description, and operational efficiency will also be considered.

Field Survey and Sampling

The need for site specific, statistically sound sampling of resource information will be management driven. A menu of sampling methods are standardized for the Rocky Mountain Region and their application will vary based on specific issues. An extremely small percentage of the overall landscape, area wise, may be intensively sampled.

Specific methods and procedures related to rangeland inventory and analysis are described in detail in the Inventory Chapter of this Guide (Chapter 3).

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RANGELAND PLANNING

PURPOSE

Rangeland planning shall prescribe management that provides sustainable, natural ecosystems for a variety of values and uses. All planning efforts shall:

- Develop clear, concise objectives that portray desired conditions of rangeland resources for the area involved.
- Develop livestock management strategies that will achieve objectives, moving rangeland resources towards desired conditions.
- Develop monitoring standards that enable managers to determine what resource changes are occurring and to make proper management adjustments.
- Develop permittee understanding and commitment for management objectives.

LEGAL REQUIREMENTS

Numerous federal laws, regulations, and policies have been enacted to provide guidance for rangeland planning.

FEDERAL LAND POLICY MANAGEMENT ACT AND PUBLIC RANGELAND IMPROVEMENT ACT

The Federal Land Policy Management Act of 1976 (FLPMA), as amended by the Public Rangelands Improvement Act of 1978 (PRIA), allows for Allotment Management Plans (AMPs) to be included in grazing permits at the discretion of the Secretary of Agriculture.[1] The Secretary has elected to exercise this discretion and has delegated his authority to issue regulations in this area to the Chief of the Forest Service.[2]

[1] 43 U.S.C.(1752(d)), as amended by 92 Stat. 1803 (1978)

[2] 36 CFR (222.1 *et. seq.*)

An Allotment Management Plan is defined in FLPMA and PRIA as a document prepared in consultation with permittees applying for livestock operations on the public lands prescribing:[3]

- the manner in and extent to which livestock operations will be conducted in order to meet multiple use, sustained-yield, economic and other needs and objectives;
- describing range improvements to be installed and maintained; and
- containing such other provisions relating to livestock grazing and other objectives found by the Secretary to be consistent with the provisions of the FLPMA.

NATIONAL FOREST MANAGEMENT ACT

The National Forest Management Act of 1976 (NFMA) directed the preparation of Forest Land and Resource Management Plans on every National Forest. Forest Land and Resource Management Plans, commonly referred to as Forest Plans, provide broad direction for all resource planning and activities. Rangeland planning attempts to implement this direction through site-specific analysis of the rangeland resource.

NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act of 1969 (NEPA), and subsequent Council on Environmental Quality (CEQ) regulations direct all federal agencies to implement a standardized process for analysis and documentation of environmental effects of a proposed action and alternatives to the proposed action. The Act requires scoping of issues, interdisciplinary team involvement in analysis and alternative development, and documentation of the analysis in an Environmental Impact Statement (EIS) or Environmental Assessment (EA). The Council on Environmental Policy Regulations[4] and the Environmental Policy and Procedures Handbook[5] contain requirements for implementing NEPA.

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[3] 43 USC (1702(k)), 36 CFR (222.1 (b) (2)), and FSM 1023
[4] 40 CFR Parts 1500-1508
[5] FSH 1909.15

THE ENDANGERED SPECIES ACT

The Forest Service is a Federal Agency bound by Endangered Species Act (ESA) requirements. Figure 2-1 shows the integration of ESA and NEPA. Section 7 of ESA[6] states:

> "Each federal agency shall, in consultation with and with the assistance of the Secretary [Interior] insure that any action authorized, funded or carried out by the agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in adverse modification of their critical habitat."

Section 7 applies to any discretionary action including granting easements, licenses, permits, and rights-of-way.

In order to fulfill its obligations under ESA, the Forest Service must consult with the U.S. Fish and Wildlife Service (FWS) and provide all pertinent project and species data necessary for them to evaluate the proposed action and its potential to jeopardize federally listed species and or critical habitat designated by the FWS. In order to comply with the ESA, agency personnel must:

1. Obtain a list of threatened, endangered, and proposed species. Contact the Fish and Wildlife Service to obtain a list of all federally listed and proposed species in the action area or that the action potentially affects.

2. Prepare a biological assessment (BA). If Federally listed species or designated critical habitat are present in the affected area, prepare a biological assessment of the effect of the proposed action on Federal land and also the effects which might occur on private land.[7] The Act requires that a determination is made in the biological assessment whether the action has:

    - no effect on, or

    - may affect

    the listed species and/or designated critical habitat. Biological assessments must be approved by journeyman level (GS-11 and above) biologists and botanists.

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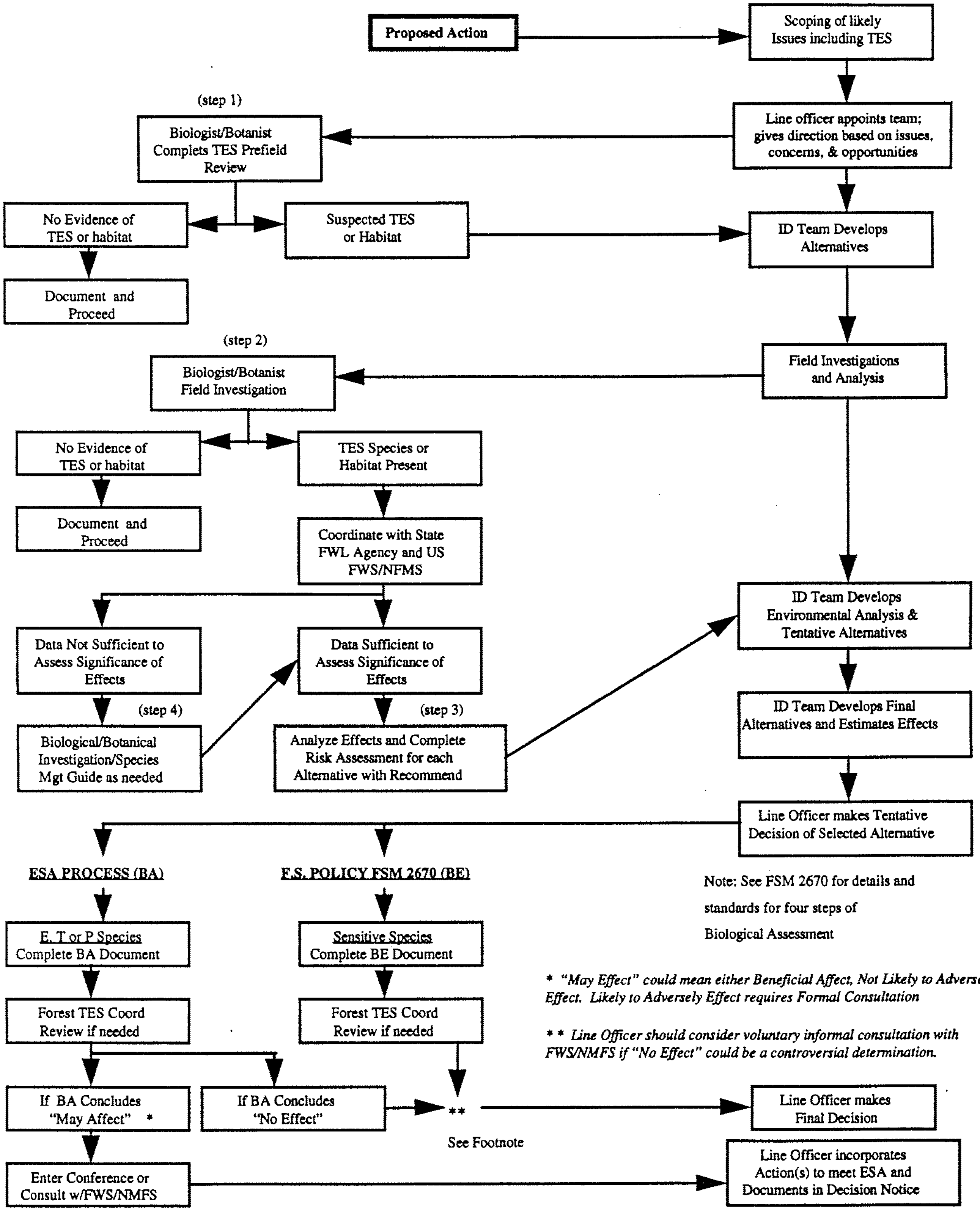
[6] 16 U.S.C. 1536(a)(2)

[7] 50 CFR 402.02

Figure 2-1. INTEGRATING ESA and NEPA



Note: See FSM 2670 for details and standards for four steps of Biological Assessment

* *"May Effect" could mean either Beneficial Affect, Not Likely to Adversely Effect. Likely to Adversely Effect requires Formal Consultation*

** *Line Officer should consider voluntary informal consultation with FWS/NMFS if "No Effect" could be a controversial determination.*

3. If a "no effect" conclusion is reached and the action does not involve a major construction project nor an EIS, consultation with the FWS is not required under the law and the action may proceed.[8] A "may affect, not likely to adversely affect" requires *informal* consultation and subsequent written concurrence from FWS. FWS does not have any specific time frame in which to conclude the informal consultation process unless the action requires an EIS, which then requires a 30-day response from FWS.

4. A "may affect, likely to adversely affect" requires *formal* consultation. Formal consultation, which must be initiated by the Regional Forester, requires that the FWS prepare a biological opinion which must be delivered to the agency within 45 days of the conclusion of a 90-day consultation period except where both agencies mutually agree to an extension. While informal or formal consultation is in progress, the agency must not make an irreversible commitment of resources that would foreclose implementation of alternative measures designed to avoid jeopardy.

The taking of a threatened or endangered species is prohibited by provisions of the ESA. However, the ESA does allow an "incidental take" provision which *may* be issued as part of the biological opinion allowing for takings that are incidental to the action and only under the terms and conditions provided in the biological opinion.

If the biological opinion states that the action is not likely to jeopardize the continued existence of the species or to result in the destruction or adverse modification of its critical habitat, proceed with the proposal. If appropriate, incorporate the FWS conservation recommendations into the proposal. The preparing unit must notify FWS in writing of the acceptance or rejection of conservation recommendations and must document the results of the formal consultation in the appropriate NEPA document. If FWS plans to render a jeopardy opinion, the FWS will contact the Regional Forester to discuss any reasonable and prudent alternatives.

Forest Service Manual (FSM) 2670 provides additional direction on requirements for compliance with ESA. Proposed species require *conferencing* as opposed to *consultation* under Section 7 of ESA.

[8] 50 CFR 402.11L

FSM 2670 should be reviewed to ensure compliance of proposed species which are also protected under the Act.

Sensitive species are designated by the Regional Forester. Requirements for protection and management are not addressed in the ESA but are provided by Forest Service policy.[9] Key requirements for sensitive species are:

1. A biological evaluation (BE) must be prepared to review proposed Forest Service actions to determine their potential effect on sensitive species.

2. Biologists or botanists must make a determination of:

   - no impact,

   - beneficial impact,

   - may impact individuals but not likely to cause a trend toward Federal listing or loss of viability, or

   - likely to result in a trend toward Federal listing or loss of viability.

3. Forest Supervisors are required to ensure compliance with procedural and biological requirements for sensitive species and to develop quantifiable objectives for managing populations and/or habitat for sensitive species. A key responsibility is developing and implementing management practices to ensure that species do not become threatened or endangered because of Forest Service actions.

Refer to Standards for Biological Evaluations[10] and Procedures for Conducting Biological Evaluations[11] for more information.

Although many requirements of the Endangered Species Act (and Sensitive Species policy) are completed by biologists and botanists, the rangeland manager must be actively involved to coordinate this effort within the scope and time frames of the overall planning process. Range personnel should be involved where necessary to conduct inventories, delineate livestock use patterns, or supply any other rangeland information to be used in biological evaluations and assessments.

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[9]FSM 2670
[10]FSM 2672.42
[11]FSM 2672.43

COORDINATION, COOPERATION, AND CONSULTATION

Proper rangeland planning requires close cooperation and consultation with a variety of National Forest and National Grassland users and interested publics. Planning must emphasize the diverse values of Americans who rely on public rangelands for recreation and economic stability. While federal laws are clear in their requirements for consultation, it remains the sole responsibility of the Forest Service line officer to make range management decisions, including how much grazing will be allowed on National Forest System administered lands.

INTERDISCIPLINARY TEAM INVOLVEMENT

Secure the assistance of the District or Forest interdisciplinary team (IDT) in all steps of the rangeland planning process. Involvement of the IDT will ensure that all resources are considered and that resource conflicts are minimized. Composition of the IDT should reflect the various issues and coordination aspects to be resolved. For example, an aquatic biologist and/or a hydrologist should be a member of the team when riparian or fisheries values are of importance. In some cases, the IDT members may accomplish (or help accomplish) some of the evaluation studies. Current planning direction prohibits non Forest Service participants from serving as *formal* ID team members.

COOPERATION WITH PERMITTEES

The grazing permittee is integral to any successful rangeland management program. The permittee has a great deal of information as to what is practical and workable concerning handling of livestock, practicality of grazing systems, and proper location and type of range improvements. The success or failure of the management program will largely be determined by the permittee's willingness to carry out the plan. Consequently, the use of National Forest System rangeland in relation to the rancher's total operation is a fundamental necessity.

Permittee cooperation is essential and their involvement in the planning process is provided for in the Federal Land Policy and Management Act. Permittees should be brought into all phases of the planning process. They should be particularly involved in setting objectives, formulating and selecting the preferred alternative, and preparation of the Allotment Management Plan.

COORDINATION WITH OTHERS

Perhaps the most essential aspect of planning is recognizing the multitude of values and uses on rangelands, and striving to develop management actions that correspond to the needs and desires of a diverse society. Rangelands are used by hunters, fishermen, hikers,

photographers, off-road vehicle enthusiasts, sightseers, and others. Americans have a keen interest in how public lands are managed. For these reasons, local individuals, user groups, and other agencies must be offered the opportunity to be involved in rangeland planning. Identify interested publics before initiating planning and involve them throughout the process. Public land users bring invaluable suggestions and boundless energy to the planning process.

Coordinated Resource Management

Coordinated Resource Management (CRM), sometimes called Coordinated Resource Management Planning (CRMP), is a formal process designed to bring all interested parties into a joint planning effort. CRM efforts are particularly appropriate when dealing with opportunities or potential effects across multiple ownerships and jurisdictions. CRM is most effective when initiated early in the planning process. Utilize CRM to identify and understand existing and desired conditions, to determine opportunities, and to identify possible management practices for consideration. Handbooks that describe the CRM process and its potential uses are available from the Society of Range Management and the State of Wyoming. These handbooks can also be obtained at most Supervisor's Offices or the Regional Office.

Document all CRM projects in an Interagency Agreement or Memorandum of Understanding (MOU) so that goals, objectives, and procedures are clear. The CRM group must be aware of how their work will be used by the decision-maker.

The Rocky Mountain Region has formal Coordinated Resource Management MOUs with the states of Wyoming and South Dakota. The regional MOU is general in nature and is not a substitute for a project level MOU. The Region and South Dakota have also enacted an MOU describing the allotment planning process.

Section 8 Agreements

Section 8 of the Public Rangelands Improvement Act of 1978[12] states:

> "If the Secretary ..... develop(s) an allotment management plan for a given area, he shall do so in careful and considered consultation, cooperation, and coordination with the ..... permittees, landowners involved, ... and any State or States having lands within

[12]Public Law 95-514

> the area to be covered by such allotment management plan. Allotment management plans shall be tailored to the specific range condition of the area to be covered by such a plan, and shall be reviewed on a periodic basis to determine whether they have been effective in improving the range condition of the lands involved..... . The Secretary concerned may revise or terminate such plans or develop new plans from time to time after such review and careful and considered consultation, cooperation, and coordination with the parties involved."

The Rocky Mountain Region has a "Section 8" MOU in the state of Colorado involving the Colorado Cattlemen's Association, Colorado Woolgrowers, and the Colorado Commissioner of Agriculture. Other states within the Region have not entered into a Section 8 MOU, but will use the CRM process instead. Activities covered by the Colorado MOU are coordinated by the State Department of Agriculture. Appendix A has details and operating procedures for the Colorado Memorandum.

RANGELAND PLANNING PROCESS

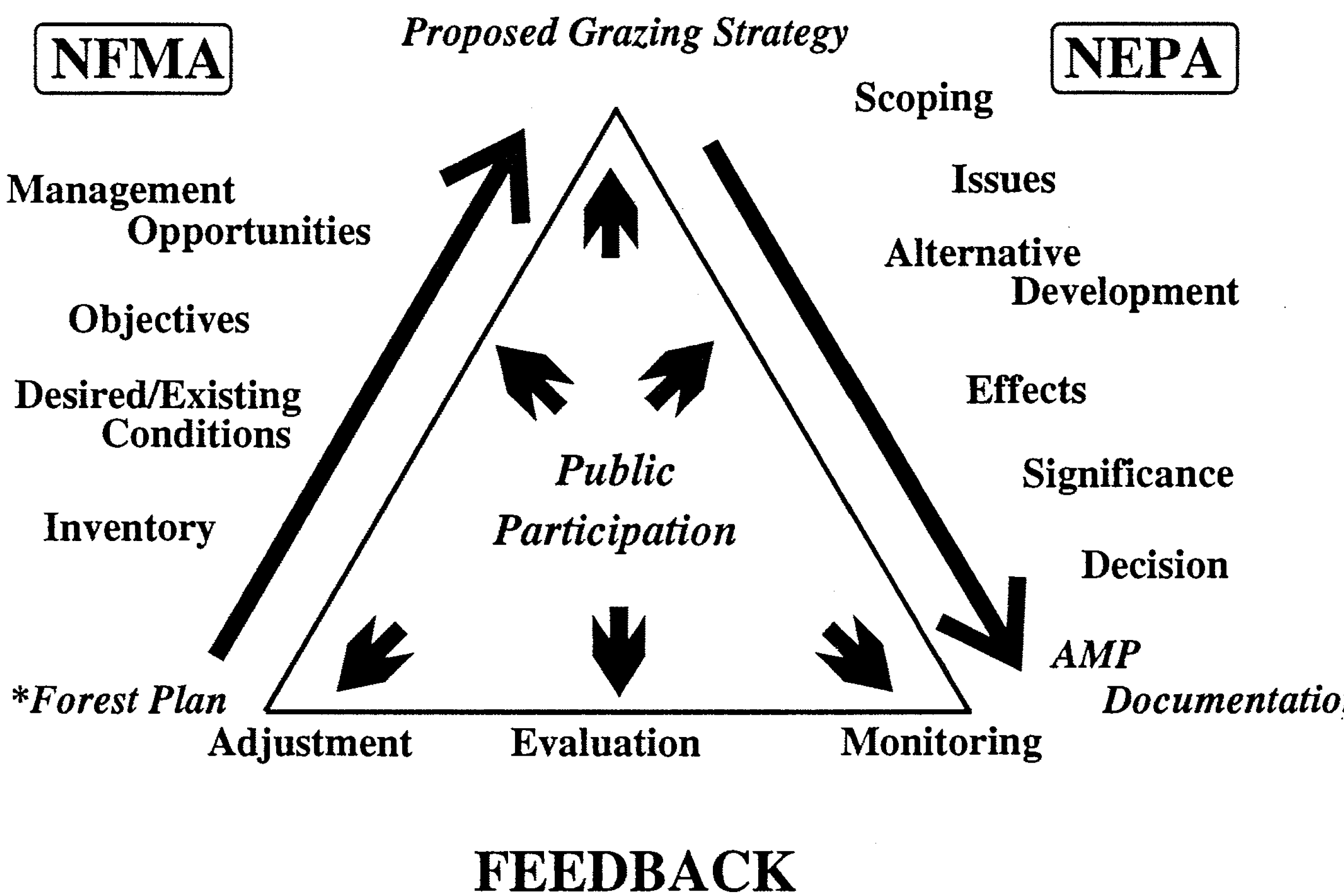
The rangeland planning process outlined on the following pages describes project level planning and decisions. This process includes the site specific analysis necessary to comply with legislation and to implement management strategies to achieve the intent of programmatic direction in Forest Plans. This process can best be described in three steps (Figure 2-2):

1. Compliance with the National Forest Management Act (NFMA).

2. Compliance with the National Environmental Policy Act (NEPA).

3. Preparation of an Allotment Management Plan (AMP).

Figure 2-2. RANGELAND PLANNING PROCESS



* Planning process begins here

STEP 1: NFMA COMPLIANCE

Compliance with the National Forest Management Act consists of defining site specific management objectives and actions that will implement the broad direction of Forest Plans. The end result is a proposed action that adds clear, specific ingredients to the intent of Forest Plans and provides the planning team with a comprehensive strategy upon which to conduct an environmental analysis and documentation. This step includes, but is not limited to, the following tasks. Each are described below in more detail.

1. Identify the planning area.

2. Determine desired and existing conditions.

3. Develop objectives.

4. Identify possible management opportunities.

5. Formulate a Proposed Action.

IDENTIFY THE PLANNING AREA

Rangeland planning should identify livestock management activities that complement and encourage progress towards the desired conditions of an entire landscape. It is important that planning not be a mechanical process, but rather be flexible, and fit the local situation.

Based upon the issues and local situation there may be several scales for planning. There are two distinct scales that are readily apparent: allotment planning, and landscape planning. These are the obvious planning scales, however there are numerous combinations of these that might be used to address the specific situation. It is essential that management decide the scope of the planning effort, and prepare a project work plan that obligates both funding and specialists time to complete the job.

Allotment Planning

In this case, as in the past, allotment boundaries continue to describe the confines of the planning area. The area might include one or more allotments. At a minimum, planning for the allotment must recognize the biological complexity of the entire ecosystem. Inventory and analysis is primarily of rangeland areas with emphasis on obtaining the information necessary to design allotment management consistent with the Forest Plan.

The level of input and participation by other resource specialists is sufficient to develop a livestock management strategy aimed at achieving the objectives for desired rangeland conditions. Inventory and analysis at this scale might not contain the necessary information and specialist involvement to support other project proposals.

Landscape Planning

In order to be more efficient, there is an increasing need to inventory and analyze land areas using integrated teams of resource specialists. The area selected may be based upon watersheds or other logical landscapes. The area is not specifically tied to allotment boundaries but can cover several allotments in whole or in part. The analysis includes forested and rangeland types.

Landscape scale inventory and analysis is an intensive approach to collecting the necessary information from which all resource project proposals can be developed. Based upon resources and issues relevant to the landscape, a team of resource specialists work jointly to analyze potential and existing resource conditions, and to propose projects to help achieve the desired conditions. Project proposals might include wildlife habitat manipulation, timber management practices, watershed rehabilitation, recreation improvements, allotment management, and others. The overall intent of this type of planning is to take a true integrated approach to managing National Forest System resources. Landscape scale planning is becoming the rule, not the exception.

DETERMINE DESIRED AND EXISTING CONDITIONS

Forest Plans reveal broad direction for resource management. Review the Forest Plan to identify management emphasis areas on the allotment (management prescriptions), and the associated standards and guidelines. Management prescriptions describe the resources that should be emphasized on certain locations within the area. Forest Plans are not intended to provide all the necessary information for rangeland project decisions. The rangeland planning process will refine the broad desired condition(s) described in the Forest Plan.

Forest Plans do not prescribe site-specific ecosystem characteristics. Specific characteristics, existing and desired, of soil, vegetation, and water can only be identified through integrated resource inventory and evaluation. Involve a diverse group of resource specialists, permittees, and interested publics to accomplish the inventory and evaluation of resource conditions.

Existing conditions are determined from inventories, trend data, historical files, and professional judgment of the planning team. Permittees provide invaluable information on past allotment history, and how that history applies to current conditions. Much of this Training Guide deals with accepted methods used to collect current resource information. While current information is important, it should be recognized that collecting existing resource data is only a portion of the overall attempt to develop a strategy to achieve the desired condition.

The quantity and quality of existing resource information needed will vary between planning areas, based upon apparent rangeland conditions, management complexity, conflicting interests, and controversy. Inventory data collected through the validation phase of Integrated Resource Inventory (IRI) may suffice on some areas, while other areas may require rigorous evaluation of vegetative, soil, and watershed parameters through combined methods. Inventory intensities are discussed in more detail in the Inventory Chapter (page 3-3). At a minimum, existing plant communities are identified and mapped through rangeland inventory.

Desired conditions are determined by identifying management emphasis areas, and then selecting the appropriate mix of plant communities needed to maximize conditions for the resource emphasized. As an example, a mix of several shrub plant communities, with varying size and age classes, may be recommended for a wildlife winter range emphasis area. Selected desired plant communities must be able to occupy the site under realistic management practices. The planning team must be able to either:

- delineate ecological types and the various plant communities that could exist there, using an approved ecological classification, or

- in the absence of a classification, the desired plant communities recommended must occur on similar sites somewhere in the vicinity of the planning area.

Instructions for determining existing and desired plant communities are described in more detail later (page 3-8).

Develop Objectives

Developing objectives is the most important portion of NFMA compliance. The toughest part of setting objectives is describing the result -- not the action to be taken. ***An objective is a clear, concise statement of measurable results to be achieved within a stated time period.*** Objectives should describe the specific resource characteristics that are desired, such as desired plant communities, water quality standards, and soil conditions. Developing objectives at this early stage in the process is paramount to a successful planning effort.

After writing an objective, read it and ask the question "*Why?*". If there is an answer which better describes the purpose of the proposed action, then the objective is not adequately described yet. For example:

Original Objective: Reduce sagebrush densities. *Why?*
To reduce competition with herbaceous vegetation. *Why?*
To achieve greater ground cover in XY drainage. *Why?*
To improve water quality in XY Creek.

This is close to an objective. Describe the water quality parameters desired and how soon they are to be achieved, and the objective will be complete. For example, the final objective may be to convert 50 percent of the sagebrush community (ARTR2-POPR) in XY drainage to a grassland community (FEID-STLE4) by the year 2005. Reasonable management opportunities can then be identified for accomplishing the objective. Identifying the opportunities becomes much easier when specific objectives are known.

Identify Possible Management Opportunities

Management opportunities that promote progress towards objectives should be identified. Opportunities might include grazing systems, improvements, vegetation manipulation, or management practices (such as riding, salting, and kind and class of livestock). Inclusion of all resource specialists, the permittee, and other interested publics is critical at this stage. The diverse composition of the planning team will encourage a broad range of management opportunities.

Evaluate all opportunities to measure their potential effectiveness in helping to achieve objectives. Good management opportunities are those with potential to move the existing plant community towards the desired plant community. Management opportunities must consider the entire ecosystem, and not be confined by artificial or jurisdictional boundaries. Identifying management opportunities should be a brainstorming endeavor that produces a wide range of innovative opportunities to be formulated into a proposed action.

FORMULATE A PROPOSED ACTION

In the ideal situation, a landscape-scale inventory and analysis (page 2-12) will provide a foundation of information that can be used for multiple resource proposals and projects. These proposals, implemented either together or individually, will accomplish the desired condition objectives that were agreed upon for the area.

At this stage in the process, land managers should decide upon the scope of the proposed action within the NEPA context. In many cases the proposed action may be strictly a livestock management strategy. In other situations the livestock management strategy may be combined with other resource activities such as wildlife habitat improvement, timber sales, recreation development, and others, to be more efficient.

At a minimum, the proposed action should be feasible for the Forest Service and permittee to implement. Specific details must be documented so that the action will address all known issues. Identification of the proposed action will initiate the National Environmental Policy Act (NEPA) compliance.

STEP 2: NEPA COMPLIANCE

Compliance with NEPA requires an environmental analysis, and documentation of the analysis in an Environmental Assessment or Environmental Impact Statement (Figure 2-3). The analysis is an investigation of the proposed action and alternatives to accomplishing that action; and their direct, indirect, and cumulative environmental impacts. The analysis provides necessary information for reaching an informed decision, and also determines the type of documentation required. The NEPA process includes:

1. Description of the proposed action and the purpose and need for that action.

2. Scoping and issue identification.

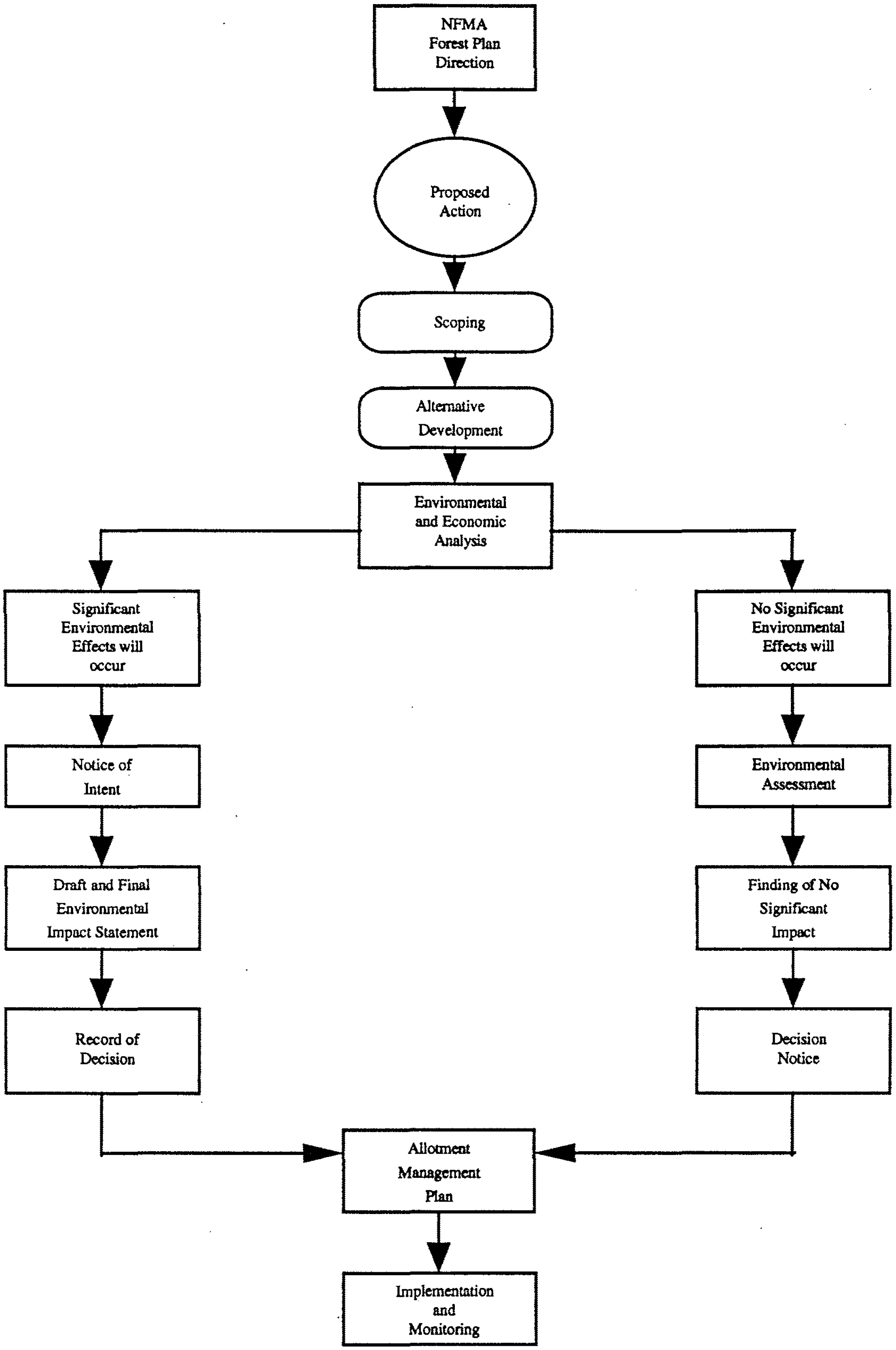
3. Alternative development.

4. Environmental and economic effects.

5. Findings based upon significance.

6. Documentation in EA or EIS.

Figure 2-3. NEPA DOCUMENTATION



NEPA requires that a formal interdisciplinary team (IDT) be established. This team may involve some or all of the planning team members included in NFMA compliance. The disciplines and skills of this group must be appropriate to the scope of the action and the issues identified. The number of persons on the team should be manageable. Other resource specialists can serve as support for a core IDT.

Forest Service Handbook[13] and Council of Environmental Quality (CEQ) regulations[14] provide detailed information on compliance with NEPA. All range managers and line officers with planning responsibilities should become familiar with these documents.

PROPOSED ACTION: PURPOSE AND NEED

This phase of the NEPA process simply consists of documenting details of the proposed action and why the action is needed. Specific details of the proposed action should be thoroughly explained so that misconceptions and unfounded conclusions are kept to a minimum. The proposed action and purpose and need are the foundation for the entire NEPA analysis.

SCOPING AND ISSUE IDENTIFICATION

This phase of NEPA compliance consists of outreach to the public for issues of concern. Many issues will have already surfaced through involvement of interested persons in NFMA compliance. NEPA scoping is broader based, and will reach out to more of the general public, other agencies, state and local governments, and others. The intent of NEPA scoping is to identify all significant issues related to the proposed action. Issues identified through scoping will often result in modification or addition to the objectives documented in NFMA compliance.

Letters, media contacts, public meetings, open houses, and other forms of notification may be required, depending upon the complexity and controversy of the planning effort.

ALTERNATIVE DEVELOPMENT

Alternative development is crucial to a good planning process. Clearly defining the objectives, purpose and need, and issues, allows the IDT to focus on development of good alternatives. All alternatives must promote progress towards achieving the objectives. With the exception of the required no-action alternative, alternatives that do not move resources towards the objectives are not reasonable. Permittees should be involved in

[13] FSH 1909.15

[14] 40 CFR Parts 1500-1508

alternative development. Alternatives that meet objectives, but cannot be implemented by the permittee, are probably not reasonable. A great deal of thought and creativity is required to develop a range of alternatives that are acceptable in terms of accomplishing the objectives. Formulating good alternatives allows for a true comparison of environmental and economic effects between the alternatives.

CEQ regulations for implementing NEPA requires that a no-action alternative be developed to serve as benchmark from which the agency can consider altering the status quo. No-action in rangeland planning is interpreted as no change from current management. Consequently, environmental and economic effects of the various alternatives are compared with those effects projected from existing management.

In addition, the *no-grazing alternative* should be considered during the planning process. However, it may not be carried forward as a reasonable alternative considered in detail. Rangeland managers can usually develop livestock management strategies that will meet or promote progress towards rangeland objectives. Very seldom will the complete removal of livestock be required to meet the objectives. No-grazing may be applicable when considering stocking vacant allotments or in situations where livestock grazing threaten the existence of a particular resource value or ecosystem function, for example, threatened or endangered species, cultural resources, or others.

Alternatives should be well thought out and defined. They must contain sufficient detail to allow for determining effects and a clear basis for choice among options. Mitigation measures should also be explained. Consider reasonable alternatives that include management of lands outside Forest Service jurisdiction.

Environmental and Economic Effects

This provides the analytical basis for comparison of alternatives. The analysis should estimate direct, indirect, and cumulative environmental effects from implementing each alternative. Estimate the effectiveness of mitigation measures for each alternative. The IDT plays a major role in insuring that effects to all resources are disclosed.

The analysis should also disclose social and economic effects. The Code of Federal Regulations,[15] the Forest Service Manual,[16] and

[15]36 CFR 222.1 (2) (i)
[16]FSM 2212.03 (8)

NEPA require allotment management plans to contain cost effectiveness analysis using prescribed cost effective procedures. Projects with an estimated cost exceeding $25,000 require a benefit-cost analysis. Projects under $25,000 require a least cost analysis. Conduct cost effectiveness analysis as part of the effects determinations. Determine cost effectiveness for each alternative using the DGECON Model.[17] Cost effectiveness should be a major consideration in decision-making.

In addition to cost effectiveness analysis there are several other legal and policy requirements to be addressed in the effects analysis. A biological evaluation or biological assessment as described in FSM 2672.43 must be prepared to determine effects on threatened, endangered, and sensitive (TES) species. Effects of each alternative upon cultural resources must also be evaluated according to Section 106 of the National Historic Preservation Act.[18] Preparation of a Noxious Weed Risk Assessment is required for all ground disturbing activities.[19] Adherence to FSM 2080 insures that the potential for spreading noxious weeds is considered in rangeland planning. Appendix B is an example of a risk assessment.

Estimating effects is really the essence of NEPA compliance. The public demands and deserves good information on the effects of proposed rangeland management. Rangeland managers, through the interdisciplinary process, should ensure that all effects are accurate and fully disclosed.

FINDINGS OF SIGNIFICANCE

The environmental analysis will determine the significance of effects on the human environment. The significance of effects will determine what kind of environmental document will be prepared (Figure 2-3). If no significant effects are likely to occur, then an Environmental Assessment (EA) is prepared. If significant effects will occur, then an Environmental Impact Statement (EIS) must be prepared. Most rangeland planning efforts will require an EA, a Finding of No Significant Impact (FONSI), and a Decision Notice that documents the action to be implemented. Rangeland planning should not be categorically excluded from documentation.

[17] Economic and Financial Analysis System, Rocky Mountain Region, May 1989, Release 3.00

[18] Public Law 89-665

[19] FSM 2080

DOCUMENTATION

Preparation of environmental documents is explained in detail in the Forest Service Handbook[20] and in the CEQ regulations.[21] Figure 2-3 illustrates the NFMA/NEPA process requirements leading to documentation of the decision. The decision document that will accompany the EA or EIS describes more thoroughly the management action(s) to be implemented on the ground.

STEP 3: AMP PREPARATION

The authority for Allotment Management Plans (AMP) lies within FLPMA and 36 CFR 222.1 and 222.2. The AMP is the implementation plan for the actions analyzed in the NEPA process and selected in the decision document. The AMP specifies the actions needed to manage rangeland resources for livestock grazing. The AMP must integrate resource goals and objectives for all resources with livestock grazing. The AMP is the implementation document by which the Forest Service communicates to the permittee and others: management objectives, planned actions to accomplish those objectives, and monitoring necessary to determine if progress towards objectives is being made. A good AMP is brief and to the point.

ELEMENTS OF THE AMP

Each allotment management plan must contain sections on objectives, management actions, improvements, and monitoring and evaluation.[22] Other sections may be added depending on the scope and complexity of allotment management. The suggested AMP outline follows.

Cover Page

A separate (approval) cover page will be used for the Allotment Management Plan. It includes the allotment name, National Forest and District name, and has preparer, permittee, recommended, and approval signatures on it. If the permittee refuses to sign, this page should state the reasons for the refusal.

Permit Statement

A statement is needed in the AMP which says: "This Allotment Management Plan is made part of your (Term/Temporary/Private Land) Grazing permit in accordance with Section .... of that permit,

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[20] FSH 1909.15

[21] 40 CFR Parts 1500-1508

[22] FSM 2212.2

approved on ..... ." This statement can be written on the cover page with the signatures.

Goals and Objectives

This section must contain objectives for management of rangeland resources and livestock grazing. The objectives are generally the same objectives as described throughout the planning process. These objectives describe the desired condition for rangeland vegetation and other rangeland resources.

This section also contains a brief summary from the Environmental Assessment or Environmental Impact Statement on the present allotment condition and situation, to put the pathway from the present situation to the desired condition into perspective.

Objectives must be clear and specific statements of planned results to be achieved within a stated period of time. The results indicated in the statement of objectives are those which are designed to achieve the desired state. Objectives must be sufficiently specific, concise, quantifiable, and measurable to allow for monitoring; must relate to desired conditions; and must contain a projected date for planned achievement (page 2-14). Objectives in the allotment management plan are basically a refinement of objectives developed during NFMA compliance.

Management Actions

This section must establish the number of permitted livestock, kind and class of livestock, season of grazing use, and grazing system to be used. The grazing system or formula must be described in words and graphic or tabular form so it is clear to all parties.

A tabular listing of range improvements, both existing and proposed, the condition of existing improvements, and a listing of maintenance responsibility is required. This section must include schedules for:

- rehabilitation of ranges in unsatisfactory condition, including noxious weed infestations, and
- initiating range improvements, with responsibilities for costs and labor incurred and planned completion dates.

This section will also describe how each grazing treatment contributes toward meeting the objectives, and how conflicts and

issues will be resolved. Management actions needed to meet the objectives for other resources and uses should be stated. Management and coordination needs for threatened, endangered, and sensitive plants and animals should be addressed. Incorporate applicable standards, guidelines, and management requirements from the Forest Plan.

Proper Use Criteria

Proper use criteria shall be put in writing for each unit or special management situation on the allotment. The criteria shall specify maximum use guidelines for key areas within the allotment, and maximum acceptable disturbance levels for stream banks and vegetation components in riparian areas. The criteria shall also specify maximum acceptable ground cover disturbance, if appropriate, to protect the soil resource. Define proper use criteria in terms of utilization levels or residue left after grazing.

Monitoring and Evaluation

This section will outline monitoring actions needed to determine if objectives are being met. From an administration standpoint, evaluation and monitoring procedures should be planned within the available resources. It may be helpful to list monitoring activities in priority of importance or specify minimum monitoring requirements. Monitoring and evaluation should address:

1. Actual livestock use, season, and numbers.

2. Ecological status and condition of suitable rangeland (acres meeting or not meeting forest plan and AMP standards).

3. Trend of benchmark ecological types and other suitable rangelands toward desired condition (for example, satisfactory livestock forage resource value rating).

4. Stream bank stability and vegetation trend in riparian areas.

5. Use intensity map to compare with the proper use criteria for firming up capacities. Include time frame for mapping to coincide with completion of grazing system and what will be done if use intensity does not met objectives, such as changes in stocking or management systems.

6. Inventoried increase or decline of noxious weed infestations.

7. Compliance with other management requirements of the Forest Plan, AMP, and annual operating instructions.

Members of the IDT should help decide what specific monitoring information will be needed in order to determine if the goals and objectives of the management plan are being met. Long-term soil and monitoring techniques should be employed to evaluate and document short term dynamic occurrences. Reference the Monitoring Chapter (Chapter 4) for a complete discussion on monitoring and evaluation.

ANNUAL OPERATING INSTRUCTIONS

Include annual operating instructions that the appropriate Forest Officer shall review each year and, in consultation, coordination, and cooperation with the permittee, revise as necessary. These instructions are in straight-forward language of what is expected and required by the permittee for the current year.

GRAZING SYSTEM DESIGN

Management system design is an extremely important part of the AMP for any allotment. A successful grazing system must:

- Move or maintain resources towards the desired condition.
- Provide watershed protection.
- Provide sustained production for livestock and wildlife.
- Be flexible to allow for unpredictable seasonal precipitation and forage production.
- Provide forage reserves for drought periods.
- Maintain or enhance habitat for wildlife and fishery resources.
- Be integrated as closely as possible with overall ranch plan objectives.
- Be simple, workable, and easily understood and followed.
- Be compatible with or enhance other resources and uses on the land.

- Be tailored to the inherent characteristics of the soil, vegetation, and topography.
- Be cost-effective in terms of construction, maintenance of necessary range improvements and management, and administration time.

Grazing Systems on Cattle Allotments

Grazing systems on cattle allotments shall generally provide for a maximum amount of re-growth after grazing. Season-long grazing should be phased out, and some form of rest or deferment should be emphasized. Rest-rotation, deferred rotation, high intensity-short duration, and several other grazing systems are acceptable. Riparian areas should be a prime consideration in designing a grazing system. Grazing systems in riparian areas should emphasize short-duration use with total rest and maximum re-growth for the rest of the growing season. No system is ideal for all situations, so the grazing pattern must be tailored to the individual allotment. Systems must be flexible so that changes can be made as needs arise.

Almost all grazing systems on cattle allotments require good water distribution. Allotment management planning should address the needs for additional water sources. Permittee salting and riding practices play a key role in the success of any management system. Salt should be placed well away from water sources and used as a means to distribute cattle throughout the unit. All grazing systems require that the permittee spend considerable time on the allotment, moving cattle out of concentration areas and sensitive riparian areas.

Perhaps the most important aspect of planning any grazing system is gaining the full support and commitment from the permittee. The rancher must be willing and able to administer the system, and the system must be realistic. A variety of grazing systems can be successful if the permittee is fully committed to the objectives and provides the necessary effort to make the system work.

Grazing Systems on Sheep Allotments

Much of the material presented in this Training Guide is oriented toward cattle management. Generally, the conceptual approach and the procedures apply equally well to sheep management but some differences should be recognized. The following information describes some of the features of sheep management and handling that must be kept in mind during management planning for sheep allotments.

Sheep Grazing Habits

Good sheep husbandry is not normally compatible with a heavy degree of use. Sheep should be allowed to seek their own level of forage utilization. They prefer different plants at different times of the year and this should be considered in designing the management prescription. Once-over grazing is highly desirable, even under rest-rotation type of management.

Sheep are finicky feeders in the morning and choose only tidbits of the choicest plant. They settle down and feed better in the evening and are not nearly as selective in their choice of forage at this time. The less the herder handles the herd, the better the animals thrive. However, in order to systematically graze an allotment, checks and controls must be applied by the herder.

Sheep prefer fresh feed each day. However, elapsed time will allow the feed to freshen up, particularly after a rain. Open herding results in less travel. If use is forced, it requires the herder to tighten up the spread of the herd resulting in trampling damage to the range and adverse effects on the sheep.

Sheep Movement and Herding

Moderate topography is best for ease of handling. Thick brush acts as a barrier to grazing sheep even though there are trails through the brush. Heavy stands of sagebrush are also barriers to a grazing herd. On most summer allotments, sheep will graze up slope after leaving their afternoon watering and bedding site. They will then come together and bed down for the night on a ridge top or some other high vantage point. They instinctively use these high points for protection and vantage. Sheep do not like to night bed in thick trees or in the bottom of basins, or depressions. From the high point, they will usually begin grazing at daybreak.

It is very important that the herder be with the flock to influence the direction when they first begin to graze. The sheep will otherwise often graze the same direction as they did the previous day, watering at the same site and bedding down on the same bed ground. This results in poor lambs and excessive trampling along the persistent routes of travel. When sheep leave the shade-up area during warm weather, they will tend to graze on the shady side of the canyon and avoid open slopes. Sheep will usually not graze downhill in the evening.

It is difficult to force sheep to shift from succulent forage to that of lower quality, such as shifting from forbs to mature grass. Feed is

generally more succulent on the cooler north and east aspects. During warm weather, sheep make good use of aspen and similar type range. They prefer to graze in the shade of the trees in the afternoons after leaving the shade-up area.

During cool or stormy weather, sheep have a tendency to travel. During warm summer days, sheep shade-up from midmorning to late afternoon. Under these conditions, sheep begin grazing at daylight and again from late afternoon until dark.

Water distribution and location are important to sheep. The ideal situation is to have water available in the bottom of every canyon. It is sometimes a management advantage to pipe water from hillsides to developments in the canyon bottom. It is difficult to force sheep to use the slopes below available water on hillsides. Watering sites should be close enough so excess trailing is unnecessary. Sheep should not be required to go more than a mile to water. Doubling the distance sheep have to travel to water increases the grazing use adjacent to the water source several times.

It is difficult to get sheep off steep slopes once they are established there. The herd will delay going to water until they are very thirsty. They will then trail (often on a run) off the slope with resulting damage to the range and slopes.

Overgrazing and Undergrazing Portions of the Range

Both the herder and the sheep follow the path of least resistance. The most accessible and easily herded portions of the range will be grazed most heavily. Areas adjacent to water, especially if water is scarce, receive heavy grazing pressure. If shade-up areas are limited, the available shady areas will receive heavy use during warm weather. Shading up too often in one place is as damaging as repetitive use of bed grounds.

Sheep also prefer the upper half of slopes and ridge tops. These areas, particularly the ridge tops, should be closely watched and evaluated. On the other hand, some portions of the range tend to be under utilized. Small isolated corners, slopes cut up or isolated by rocks or brush, the lower portions of long slopes, slopes below available water, steep, rough country, and some of the timbered areas fit into this category.

Additional Considerations

Other factors to consider when designing grazing management on sheep allotments are:

1. Where possible, avoid placing allotment boundary lines (common to two allotments) on ridge tops. Sheep naturally prefer to graze the upper portions of slopes and ridge tops. When allotment lines are placed on ridge tops, the result is double use on these areas. Sheep from both sides of the ridge graze and may bed on the ridge top. Some problems can be alleviated or corrected by placing common boundaries on drainage bottoms.

   It is recognized that many boundaries are more or less fixed and are difficult to change. Where this situation occurs, provision should be made to alleviate problems with special instructions to the permittee and the herder. These instructions normally should be placed in the annual operating instructions. The instructions may prohibit bedding the sheep on certain ridge tops and/or specify that these areas receive only light use.

2. Sometimes there are small unsuitable areas within large areas of suitable range. These areas may have shallow soil with very little vegetation which should not be grazed. These areas are sometimes delineated on maps furnished to the herder and owner and shown as "closed to grazing." This creates an impossible situation for the herder due to the impracticality of keeping sheep off many of these small areas.

   When this situation exists, the range manager must choose between two options:

   - change the grazing formula either to protect these areas or to enable them to be grazed in a manner that they would not be damaged, or

   - close a large enough area around the unsuitable sites so that it is possible for the herder to keep the sheep off of them.

3. Sheep should be managed on the basis of "once-over" grazing under rest-rotation or deferred rotation management. On cattle allotments, cattle are placed in a pasture or grazing unit and confined there until the desired degree of use is obtained. This approach is undesirable with sheep.

Permittees usually want their sheep with lambs on fresh feed every day to put weight on their lambs. If sheep are kept confined in a grazing unit until heavy utilization is attained, the lambs will not do well and the permittee will be opposed to the grazing management system. Likewise, if sheep are confined to a grazing unit until relatively heavy utilization is attained, the soil damage from trailing and trampling by sheep is usually unacceptable.

RANGELAND INVENTORY

INTRODUCTION

This Chapter provides the basic information necessary to conduct a rangeland inventory. It is designed to provide instruction for field survey and sampling of all active grazing allotments. Rangeland inventory involves identifying plant species composition, determining relative health of the rangeland, preparing an allotment analysis map, and recording and summarizing data for range planning decisions. In order to conduct a reliable inventory, good plant identification skills are mandatory.

There are two situations that will be encountered in the Rocky Mountain Region:

1. inventory of areas *without* a formal ecological type classification, and

2. inventory of areas *with* a formal ecological type classification.

The inventory procedures utilized depend on whether or not a classification is available. Most rangeland areas within the region do not currently have a formal classification.

WITHOUT A CLASSIFICATION

Since potential natural communities (PNC) are not known on areas without a classification, the inventory process must concentrate on existing vegetation. Specifically, the inventory process will involve delineation of existing plant communities according to Integrated Resource Inventory (IRI) procedures, and comparing the existing community to a desired plant community. The degree of similarity between existing and desired plant communities gives an estimate of vegetation management status (page 3-13).

Desired plant communities are those which are found within the general area, on sites with similar environmental characteristics, and are preferred for a particular set of resource attributes. Resource value ratings are also estimated for each existing and desired plant community.

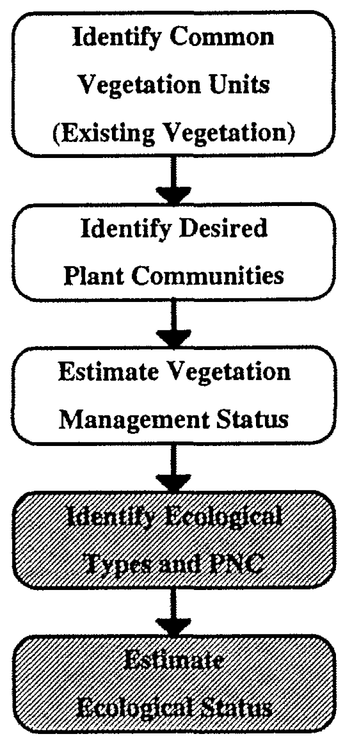
WITH A CLASSIFICATION

Potential natural plant communities and seral communities, are identified in a formal ecological type classification process. Rangeland inventory on areas with a classification involve estimating vegetation management status, through the process outlined above, plus comparing the existing plant communities to potential natural communities to estimate ecological status.

RANGELAND INVENTORY REQUIREMENTS

The inventory process is portrayed in Figure 3-1 and discussed in detail throughout this Chapter.

Figure 3-1. RANGELAND INVENTORY PROCESS[1]



[1]The first three steps are required for all inventories. The latter two steps (cross-hatched) will be completed only if an ecological type classification is available.

PRIORITIES AND INTENSITY

Rangeland analysis is the systematic collection and evaluation of rangeland resource data. The Forest Supervisor shall establish priorities for analysis considering the following factors:

PRIORITIES FOR ANALYSIS

1. Allotments not meeting Forest Plan standards and guidelines.

2. Allotments with threatened, endangered, or sensitive plant or animal habitat that are impacted by livestock grazing.

3. Allotments with big game-livestock conflicts.

4. Allotments not in the above criteria without NEPA or Forest Plan compliance documentation.

INTENSITY OF ANALYSIS

Minimum requirements for accomplishment of the inventory phase of the rangeland analysis process can be found in FSM 2212.11.[2]

Factors to be considered in determining sampling intensity are: complexity or sensitivity of known or anticipated resource use conflicts or controversy, diversity of vegetation types, present ecological status, trend, and the desired level of precision. Sampling intensity is dependent on the kind, quality, and quantity of data needed. In determining the sampling intensity, the examiner should weigh the desired level of inventory against funding and personnel capabilities. Professional judgment plays a major role in making these determinations. Table 3-1 provides guidelines for determining the appropriate level of inventory intensity.

AREA INCLUDED

Rangelands to be analyzed include:

1. Rangelands within the allotment which are grazed by permitted livestock, including non Forest Service administered lands if those lands are used as basis for private land permits.

2. Public and private rangelands within or adjacent to allotments where the Forest Service is cooperating with other Federal agencies, state agencies, or private landowners in the development of coordinated allotment management plans.

3. Rangelands outside active allotments as necessary to meet objectives for resources such as wildlife or watershed.

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[2]Also refer to FSM 2060 and FSH 2090.14.

Table 3-1. INTENSITIES OF ANALYSIS

INTENSITY	BASE LEVEL	MID LEVEL	HIGH LEVEL
WORKING RELATIONSHIP	Cooperative	Cooperative or potential for conflict	Non-cooperative
RANGELAND CONDITION	Satisfactory	Some areas are unsatisfactory	Unsatisfactory
GRAZING MANAGEMENT	Minor or no changes will be sufficient	Moderate changes in grazing system or improvements will be required	Major changes in stocking levels and/or management strategies needed
OTHER RESOURCE ISSUES OR CONFLICTS	No significant issues or resource conflicts exist	Potential issues have been identified and minor conflicts expected to develop	Major issues have been identified; conflict resolution necessary
ALLOTMENT MANAGEMENT PLANNING	Need rewritten/easy AMP design and straight forward EA	Moderate changes in AMP will be required, with an EA	Major changes with EA or EIS
PERSONNEL REQUIRED	Team Leader plus a few technical consultants	Team Leader plus a small interdisciplinary team	Full interdisciplinary team including specialists
PROCEDURES	1. Allotment Boundary Map showing pastures 2. Map existing and needed improvements 3. Map all CVUs 4. Inventory with ocular plant composition plots 5. Vegetation management status (and ecological status if classification is available) 6. Determine RVRs 7. Monitor extensive	Base level, plus: 7. Map key areas 8. Monitoring will be extensive for satisfactory areas and more intensive for unsatisfactory areas (transects will usually be required) 9. Install cover-frequency and/or line intercept transects as a minimum; they will be supplemented with ocular plant composition plots	Mid level, plus: 10. Install cover-frequency overlapping rooted nested frequency transects to monitor trend as well as other necessary monitoring procedures 11. Closely monitor allotment for minimum of 3 years or one full rotation period

OFFICE PREPARATION

Office preparation includes gathering available information contained in the 2210 and 2230 folders. Much of the preliminary aerial photo interpretation can be done in the office and verified during field work. Sources of information include:

1. Forest Land and Resource Management Plan, especially the inventory and data base, and the maps prepared for the Plan.

2. IRI photo-interpretation and field verification maps and data base.

3. Old range maps and records.

4. Old allotment management plans.

5. Timber survey, range site (SCS), soil inventory, and soil-vegetation maps, such as Multiple-Use and Area Guides.

6. Annual range inspections, and range readiness, utilization, and actual use reports.

7. Personal testimony by permittees, State wildlife agency personnel, public groups maintaining data bases on ecology, and Forest users. Grazing permittees can provide information on locations of existing and needed range improvements, suitable range, problem areas, and livestock distribution and use habits.

8. Aerial photographs (recent and past).

9. Photographs and camera point records.

10. Wildlife use, census, and habitat analysis records.

11. Fish and Game Department reports and studies.

12. Land adjustments and status records.

13. County records for land ownership.

ALLOTMENT FAMILIAR-IZATION

It is imperative that field examiners be intimately familiar with the allotment regardless of the inventory intensity level used. There is absolutely no substitute for personally conducting all the following:

1. Review allotment folders and files concerning the allotment. These records provide insight into the history of grazing use and various problems and opportunities on the allotment. Discuss the allotment with the permittee(s) and other interested parties in order to determine past and present use, patterns of livestock use and movement, problem areas, potential range improvements, and so on.

2. Become knowledgeable concerning the presence of threatened, endangered, and sensitive plant and animal species and their habitats within the allotment. The Forest wildlife biologist or botanist can assist with this as well as The Nature Conservancy which has offices in all Rocky Mountain States.

3. Locate and describe desired plant communities (DPC) and/or potential natural communities (PNC) on specific ecological types. Data from these areas is required to develop ecological type classifications and to prepare ecological guides. Search unsuitable portions of the allotment for undisturbed or relatively undisturbed occurrences of DPC or PNC. However, when comparing unsuitable areas with other portions of the allotment, *care must be taken to assure that they are the same ecological type.* Habitat types have also been described in some areas of the Region and can be used to describe potential natural communities. Suitability criteria is discussed in more detail later (page 3-9).

4. Observe the use patterns of livestock and wildlife. Utilization studies are helpful aids.

5. Identify key areas for wildlife species of interest on the aerial photos or GIS base maps, by coordinating closely with wildlife biologists and local state wildlife officials.

6. Determine if soil inventories have been accomplished on the allotment. If available, use them to the fullest possible extent. If soil inventories are not available, or if the inventory cannot be scheduled to coincide with range analysis, the project leader must arrange for the collection of soil information with the help and advice of a soil scientist. In addition, soil parent material should be observed along with general observations on watershed damage, gully systems, and sheet erosion.

7. Observe and record all water locations on aerial photos or GIS base maps. Water availability and location are major factors influencing livestock and wildlife distribution. It also has a bearing on range suitability and influences range management planning. In areas where water is in short supply or is poorly distributed, there may be a greater potential for conflict between the various uses.

8. Become familiar with allotment boundaries and accurately locate each boundary on aerial photos with a stereoscope, or on the GIS base map. These lines should be ground-truthed to be certain that they conform with the approved written boundary description or map.

9. A knowledge of basic plant ecology is essential to determine resource values and potentials, and to establish management goals. At a minimum, one team member must be familiar with the vegetation of the area and be able to identify all the plant species. PNC can best be determined from prepared ecological guides and through examination of protected areas which have not been grazed by livestock.

FIELD DATA COLLECTION

Field data collection is perhaps the most essential, but time consuming aspect of range analysis. Data collected in the field will be used as the basis for allotment management decisions as described in the Planning Chapter (Chapter 2). Field data should be recorded on appropriate forms and noted on the field map or aerial photo. Field sampling will provide information on: range improvements, existing vegetation, desired plant communities, suitability, and production.

RANGE IMPROVEMENTS

Existing range improvements within the area or allotment should be inspected and accurately located on aerial photos or appropriate field maps. Condition of the improvements should be noted, as well as future reconstruction needs.

Existing Vegetation

Common vegetation units (CVU) should be identified, mapped, and described according to IRI standards. Common vegetation units are areas with similar vegetative characteristics. There are seven factors used to delineate common vegetation units: physiognomic class, species, density, size, crown condition, vertical structure, and horizontal structure.

Field work will concentrate on adjusting and correcting CVUs based upon what is actually found on-the-ground. Minimum size of the units is not fixed. Small units may be extremely important if they produce large amounts of forage or provide important values for other resources. Unit size ultimately depends on the amount of information needed by the line officer to make an informed decision. The IRI Training Guide provides additional information on delineation criteria and procedures.

Perhaps the most important field inventory task is to describe the existing plant communities within the common vegetation units. Any method described in this Chapter can be used to describe vegetation characteristics. Soil descriptions are an important part of understanding the analysis area, and evaluating and managing the resources. Use the appropriate inventory method indicated in Table 3-1. Temporary or permanent plots can be used. Locate all plots within key areas representative of the entire unit, and accurately document plot locations on the field map or aerial photo.

Desired Plant Communities

Selecting desired plant communities is crucial to effective rangeland planning. The DPC has composition, structure, and function characteristics which best represent the desired condition specified in the Forest Plan. DPC is one aspect of the overall desired condition and must be integrated with other features, for example, soil and visual characteristics. Identifying a DPC is a collaborative process involving a local interdisciplinary team and including any other interested entities. The team should document the reasoning behind the selection of desired plant communities. Forest Plans identify management areas with particular resource emphases. The role of inventory is to identify plant communities that possibly provide high quality resource conditions for the management area.

Often the existing plant community complies with Forest Plan direction, providing a broad range of resource benefits. In this situation the allotment management planning objective should be to maintain the existing plant community.

In other cases, there may be other appropriate plant communities that would better comply with the Forest Plan. The desired plant community should provide a broad range of values for all resources, but should be primarily selected for the management emphasis in the Forest Plan. Desired plant communities must currently exist in the general area, and are capable of occupying the site within a reasonable time period, through a management change. The rangeland manager must realize that there are many communities that will be difficult to change through normal management practices. For example, many bluegrass dominated sites in the Region exist due to prolonged, past overgrazing. It is extremely difficult to convert them back to a bunchgrass community.

Additionally, there are many dense sagebrush dominated communities that have evolved through a combination of grazing and natural succession. Neither of these situations can be corrected with just changing grazing management strategies. They will require some additional form of disturbance to move the existing plant community towards the DPC. Objectives which convert the existing plant community to another community must be reasonable.

The inventory crew, or at least the crew leader, must be familiar with management areas listed in the Forest Plan. The inventory crew will locate desired plant communities and then describe vegetation and soil characteristics. Relict areas, research natural areas, and old exclosures or pastures may furnish valuable information. The same method(s) used to sample existing vegetation should be used to sample the desired plant community. For every common vegetation unit the interdisciplinary team will determine if the existing vegetation is the desired plant community or if a different plant community is preferred.

RANGELAND SUITABILITY

Field inventory will identify rangeland suitability for livestock use. The inventory should also identify suitability for wildlife (especially indicator species and other target species identified in the Forest Plans). Most of the discussion in this section dwells on livestock suitability. Suitability determinations for wildlife will consider grazing habits and food-cover relationships as directed by wildlife and fisheries biologists.

Classification of Rangeland Suitability for Livestock

1. **Suitable Rangeland**. Suitable rangeland is accessible to livestock, produces forage or has inherent forage-producing capabilities, and can be grazed on a sustained yield basis under reasonable management practices. Areas that produce forage and become accessible as a result of timber management practices, fire, or other events may be classified as suitable range. Such areas frequently are called transitory range even though forage may be produced ten or more years before natural or man-caused changes terminate it. Many prescribed burns, especially in tall brush or timber types, create transitory range.

   Rangeland meeting the above criteria, but not available for grazing because of land management decisions, is still classified as suitable range. Such areas may be closed to grazing and the reason for closure indicated. Closed areas of suitable range should be reviewed periodically and reopened to grazing if the reason for closure no longer exists.

   Suitable rangeland should be identified and mapped based on:

   a. patterns of use by livestock under the existing management and range improvements, and

   b. expected changes in patterns of use resulting from specified changes in management and improvements.

   Suitability maps often pinpoint opportunities for improved utilization in an allotment.

2. **Unsuitable Rangeland.** This category includes areas which should not be grazed by livestock because of unstable soil, steep topography, lack of management improvements, or inherently low potential for production. Some primary considerations are:

   a. Physical characteristics of the terrain such as steepness and length of slope and natural barriers.

   b. Soil and vegetation characteristics which may be classed as unsuitable (as determined by Forest suitability criteria) because of limitations such as:

- Loose granitic soil on steep slopes.

- Highly erosive soil from shale and mudstone.

- Areas of insufficient vegetative cover to protect the soil from erosion, where restoration would not be possible or practical under continued grazing use. However, soil protection (erosion potential) should not be a criteria by itself for determination that the range is unsuitable for grazing. Rangeland may be in a depleted condition due to past abuse. It may provide little forage currently, but should be classified as suitable if it meets all other criteria.

- Boggy areas which prevent livestock use.

c. Areas that would otherwise be suitable except for the lack of appropriate range improvements, such as water developments, fences, or vegetation manipulation.

Standards and Guides for Suitability Classification

Written suitability criteria must be prepared by an interdisciplinary team in advance and approved by the appropriate line officer. Upon completion of field inventory, the approved suitability criteria should be retained with the analysis data as a permanent record. Suitability criteria shall be consistent with Forest Plan criteria. The following elements should be considered in developing suitability criteria:

1. **Site Productivity.** Productivity of a site should be evaluated in pounds of herbage and browse produced annually per acre. The minimum acceptable productivity is the level below which it would not be feasible or practicable to graze livestock. Lands which are not capable of producing at least 200 pounds total dry weight of forage per acre per year are usually classified as unsuitable and require no further consideration.

2. **Soil Stability.** Soil stability is the inherent ability of soil to resist erosion. It depends on several factors, principally climate, erodibility, topography, and cover. These factors are used to evaluate erosion potential or erosion hazard. The following factors affecting soil stability may be considered in developing suitability guides:

a. Erodibility is the inherent tendency of soil to erode without consideration of climate, topography, or cover. It is based on:

- the strength and size of the surface soil aggregates, and

- profile characteristics, such as texture, depth to restrictive layers, and coarse rock fragments on the surface and in the profile which affect infiltration, percolation, and storage of water.

b. Slope gradient, length, roughness, shape, and aspect affect erosion hazard. Long slopes build up greater heads of water than short ones. Steep slopes are more subject to erosion by overland flow than are gentle slopes, because the erosion capability of overland flow increases as the rate of flow increases.

c. Cover consists of vegetation, litter, and rock fragments. The amount, kind, and dispersion of cover determines its efficiency in protecting the soil from accelerated erosion.

3. **Physical Barriers.** Physical barriers include steep slopes, cliffs, brush, trees, down woody debris, rock, and other obstructions that restrict free movement of livestock. Range classified as unsuitable because of barriers should be reclassified if the obstructions are removed.

4. **Management.** The kind of livestock grazed and the management system applied to a rangeland may affect suitability. A change from band herding to herderless fenced pasture sheep management may result in safe use of areas previously identified as unsuitable because of soil damage risks. Intensified management may result in the need to redefine suitability criteria.

5. **Interrelationships.** Consider how the factors of soil stability, erosion, accessibility, slope, and distance to water interrelate to determine suitability. For instance, one mile to water on flat ground could be suitable range for livestock, but one mile to water on a 40 percent slope might be unsuitable range.

APPLICATION OF INVENTORY DATA

The following is a discussion of some applications of inventory data. There may be other applications that arise in the future.

EVALUATION OF STATUS

There are two separate but related approaches in which inventory data can be used to evaluate status. The first is the evaluation of vegetation management status, based on the desired plant community. The second is the determination of ecological status based on the potential natural community.

In order to keep these approaches distinct, it is important to clearly understand ecological type concepts. Specifically, knowing and understanding the qualitative and quantitative difference between existing and potential natural communities, the nomenclature used to discuss them, and their application, is essential. Following is an explanation of the relationship between these concepts and a sample application of rangeland inventory data. Some variability in application will be required, dependent on the type and quality of ecological classification products available.

Vegetation Management Status

The evaluation of vegetation management status and ecological status are somewhat similar. The difference is that for vegetation management status existing vegetation data is compared to the desired plant community, while for ecological status the same existing vegetation data is compared to the potential natural community. Figure 3-2 illustrates this relationship.

Figure 3-2. RELATIONSHIP OF POTENTIAL NATURAL COMMUNITIES AND SERAL COMMUNITIES

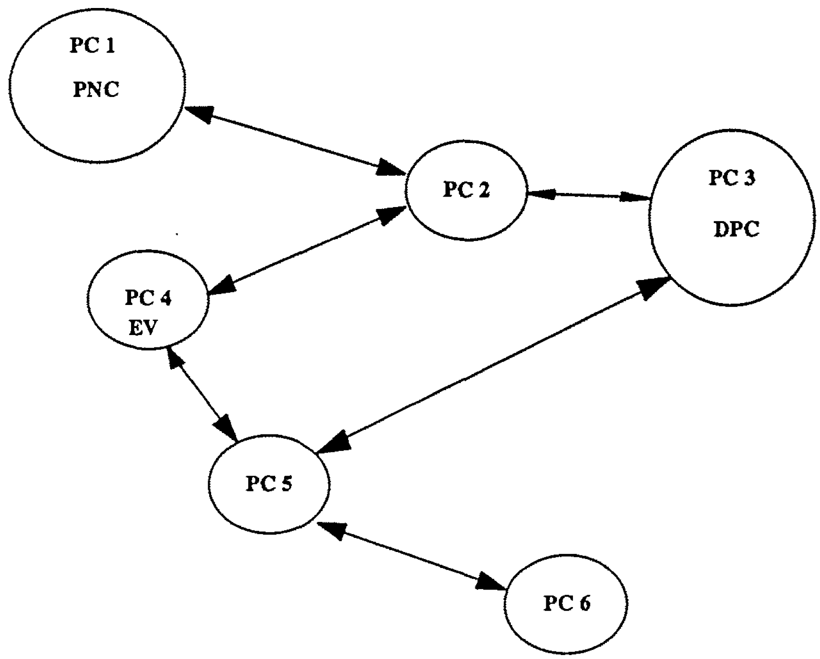


Figure 3-2 illustrates a hypothetical ecological type, with each circle representing a plant community which may occur. The lines represent successional relationships between the various plant communities. In other words, there is a direct successional relationship between PC6 and PC5. But there is no direct relationship between PC6 and PC3. Changes between any two communities, consistent with the arrows, occur because of the presence or absence of disturbance. In addition, the rate of change is influenced by periodicity, intensity, and duration of the disturbance events. The events may be natural, or the influence of management activities.

In this hypothetical illustration, existing vegetative condition is represented by PC4 and the desired plant community is represented by PC3. Both communities are seral to the potential natural

community, PC1. Vegetation management status is the relationship, or similarity, between PC4 and PC3.

The evaluation of vegetation management status provides the rangeland manager with a yardstick for evaluating the similarity of existing vegetation to a desired plant community. Similarity is an evaluation tool normally available in the absence of an ecological classification.

Ecological Status

Ecological status is the degree of similarity between the existing plant community and the potential natural community. Ecological status cannot be accurately determined unless an ecological type classification is complete. Determination of ecological status will be based on the specifics of the ecological classification.

SIMILARITY COEFFICIENTS

Characteristics such as species composition and abundance, soil condition, and ground cover are considered in the evaluation. Vegetation management status is determined by comparing canopy cover-frequency indices by species between the existing plant community and the desired plant community. Ecological status is determined by comparing canopy cover-frequency by species between the existing plant community and the potential natural community. Cover-frequency index is based on the procedure developed by Dan Uresk (personal communications).

In the absence of an ecological classification it is difficult to determine a general or acceptable level of similarity for all types of communities. The inherent variability of natural communities can lead to difficulty in achieving high similarity values.

Cover-Frequency Index

Similarity coefficients are computed on the worksheet provided (R2-2200-SC). The coefficients are a function of canopy cover and frequency. The result is the canopy cover-frequency index (CFI). It is similar to the index developed by Uresk.[3]

$$\text{Average Canopy Cover} \times \%\ \text{Frequency} = \text{CFI}$$

[3]Uresk, Daniel W. 1990. Using Multivariate Techniques to Quantitatively Estimate Ecological Stages in a Mixed Grass Prairie. J. Range Manage. 43:282-285.

Using the index is inherently stronger than using either canopy cover or frequency by itself. Computing the index is described in more detail in the Cover-Frequency Method section (page 3-57).

Computing Similarity Coefficients

Calculation of similarity coefficients can be made by utilizing R2-2200-SC. Any inventory method can be used to collect the data (see Inventory Methods, page 3-33), however, a single ocular plant composition sample will not provide frequency data. Several ocular plant composition plots averaged together will approximate frequency data, analogous to computing frequency from several plot frames on a cover-frequency transect. The coefficient of community similarity is determined by using:

$$\frac{2w}{a+b}$$

where:

$a =$ is the sum of values for measured parameters of existing vegetation,

$b =$ is the sum of values for measured parameters in the desired plant community (vegetation management status) or the potential natural community (ecological status), and

$w =$ is the sum of the values for the measured parameters that are common to both.

The values to be summed for "w" are obtained by comparing the existing and desired values (or measures). The amount similar is the lesser of those two values for each species. "w" then is the sum of the similar portion for all species.

Interpreting Similarity Coefficients

As with any model developed for natural resource application, similarity coefficients *do not* provide black and white conclusions. Similarity coefficients *do* provide one evaluation of the similarity between two plant communities. This point cannot be over-emphasized. The allotment management plan resulting from rangeland analysis will be the composite product of many different pieces of information.

Therefore, the similarity coefficient is merely *one* guide or tool, by which the similarity of two plant communities can be evaluated. The break between acceptable and unacceptable vegetation management status is established at 75 percent similar (Table 3-2). Professional judgment and common sense is needed to interpret similarity data. This is especially true at the low end of an acceptable rating or the high end of an unacceptable rating.

Preliminary data analysis indicates that often a 60 or 70 percent similarity is acceptable for many community types. At these levels of similarity many communities with the same dominant species will appear similar, and for management and community description purposes, they can be grouped together. Likewise, an 80 or 85 percent similarity may be unacceptable dependent on which species are present and which species are desired.

It is the responsibility of the rangeland manager to interpret similarity coefficient results and to thoroughly document whether the similarity evaluation is accurate or not. Application of similarity coefficients is inherently risky without a more complete understanding of the vegetation community relationships and ecological significance of specific plant species. Identifying and describing these components is one objective of ecological type classifications.

Table 3-2. VEGETATION MANAGEMENT STATUS

Similarity Coefficient	Vegetation Management Status
75-100%	Acceptable (similar to the desired plant community)
0-74%	Unacceptable (not similar to the desired plant community)

SIMILARITY COEFFICIENT (R2-2200-SC)

Forest Headwaters	District Red Cloud	Plot ID
Allotment Name and Number Turret Peak	Pasture Pat Park	
Year of Study 1993	Date 6/25/93	Examiner(s) MJB
Potential Natural Community ARTRV/FEID/Agric Cryoborolls	Existing Plant Community ARTRV/FEID	Method of Measurement Cover-Frequency Transect

SPECIES	Canopy Cover-Frequency Index by Species: Present	DPC	Similar	NOTES
POTR5		100		
SABE2		500		
ARTRV	293	250	250	
SYOR2	1	75	1	
CHNA2	353			
CHVI8	10			
RILA		80		
SARA2		50		
FETH	170	500	170	
CAEL3	7	100	7	
POPR	520	100	100	
PONE2	1500	750	750	
CAGE2		100		
KOMA	7	50	7	
CAFI	1			
KOCR	8			
PASM	25			
BROMU	115	25	25	
ELEL5	1			
ACLA5	1083	700	700	
TAOF	1327	500	500	
MEFU2	180	250	180	
LATHY	323	100	100	
VIAM	110	75	75	
DEBA2	110	75	75	
RAGL	11	25	11	
NOMO2	11	25	11	
ANSE4	10			
GASE6	10			
ERIOG				
PHMU3	1			
ANAM	1			
	(a)	(b)	(w)	
TOTAL	6188	4430	2962	
Similarity Coefficient (%)			56%	(2w) ÷ (a + b) = % Similar
Vegetation Management or Ecological Status			Unacceptable	Present ÷ DPC Ground Cover = % Similar
Ground Cover (%)	1437	4025	36%	low erosion control resource value

Table 3-3. INTERPRETING RANGELAND CONDITION FROM VEGETATION MANAGEMENT STATUS AND TREND

TREND	VEGETATION MANAGEMENT STATUS	
	Unacceptable	Acceptable
Toward	Satisfactory	-
Static	Unsatisfactory	Satisfactory
Away From	Unsatisfactory	Unsatisfactory

RANGELAND CONDITION

Rangeland condition can be described by combining vegetation management ratings with trend determinations. For example, a plant community with an acceptable vegetation management status and a trend "away from" management objectives would be considered in unsatisfactory condition (Table 3-3). Likewise, an "unacceptable" vegetation management status with a trend "towards" objectives might be considered in satisfactory condition. Determining trend is described on page 3-24.

RESOURCE VALUE RATINGS

A resource value rating (RVR) is the quantification of a particular use or benefit for an ecosystem. RVRs are part of the characterization of an ecological type and associated seral communities in an ecological classification. They can be determined for any plant community as long as the coefficients associated with individual species or combinations of species is known. RVRs must be set within the capability context of the plant community and can be expressed with adjective ratings such as low, moderate, and high. In addition it will be useful to establish stocking guides (acres/AUM) for livestock use.

RVRs are usually developed for individual plant species. This approach must be extended to assemblages of plant species. In this fashion, RVRs can be developed for each plant community and be better suited for ecosystem management application. The RVR list should be developed at the Forest, or possibly District, level through an interdisciplinary process, and supplemented as the ecological classification is done. The following is an example of RVRs.

> One desired plant community in a mountain allotment is the Big Sagebrush - Idaho Fescue (ARTR2-FEID) plant community. The resource value ratings determined by the local District staff for that plant community are in Table 3-4.

Table 3-4. SAMPLE RESOURCE VALUE RATINGS

Resource of Interest	Resource Value Rating
Forage for cattle	High (during summer)
Forage for sheep	Low
Forage for deer	Low
Nesting habitat for ground birds	High
Water quality	High

SOIL RATINGS

Erosion rates are difficult to measure directly. Erosion hazard is related mainly to effective vegetation, litter, and other ground covers. Ground cover can be determined from the cover-frequency or rooted nested frequency sampling methods. Minimum quantities of vegetation and litter cover to prevent excessive soil erosion should be established for each ecological type by evaluating areas representative of natural erosion rates. These comparisons or standards will be adjusted for slope and aspect. Soil ratings may be expressed as the ratio between vegetation/litter cover on the site and vegetation/litter cover for the ecological type.

DETERMINING INITIAL GRAZING CAPACITY

In most cases in the Rocky Mountain Region, grazing has taken place for many years and grazing capacity estimates have been adjusted based on actual use observations (see Monitoring Chapter, page 4-10). However, in those instances when initial capacity needs to be determined (new allotment or reactivation of vacant allotments) the following procedure can be followed (see R2-2200-GA, Grazing Allotment Summary and Livestock Capacity Estimate):

1. Determine total forage production on each common vegetation unit considered to be suitable range (see Clipping and Weighing, page 3-95).

2. Multiply pounds per acre in each common vegetation unit by proper use factor (a maximum of 40-45 percent for initial stocking rates) and the number of acres. This amount is available forage.

3. Total the available forage production for all map units.

4. Divide available forage by the daily dry weight consumption rate (Table 3-5) for the kind and class of livestock permitted.

GRAZING ALLOTMENT SUMMARY and LIVESTOCK CAPACITY ESTIMATE (R2-2200-GA)

Forest **GM/UNC/GUNN NF**		1. Gross area of allotment	**10,723**
District **TAYLOR RIVER RD**		2. Alienated land, no capacity estimate	**--**
Allotment Name and Number **RED CREEK**		3. Total area open (#1 - #2)	**10,723**
Kind and/or Class of Animal **C/C**		4. Unusable area (UN)	**2,115**
Allowance (lb/day/animal -- dry wt.) **34#/DAY**		5. Closed to livestock use	**--**
Field Work Completed (Date) **93/08/01**		6. Total area unusable (#4 + #5)	**2,115**
Examiner: **J. POPE**		7. Total open and usable (#3 - #6)	**8,608**
Summary Completed (Date) **94/02/15**		8. Alienated land open and usable	**--**
By: **J. POPE**		9. NFS land usable and open (#7 - #8)	**8,608**
		10. Estimated Carrying Capacity (AUM) (from back)	**1,578**

OBLIGATION AND RATE OF STOCKING: Permits and Past Actual Use

	Animal Kind	Animal Class	Animal Numbers	Season	Animal Months	Animal Unit Months
Term Permit	**CATTLE**	**C/C**	**320**	**6/15-10/15**	**1280**	**1664**
Permit						
Permit						
Permit						

Year	19 87	19 88	19 89	19 90	19 91	19 92	19 93	19____	19____
Number of Animals	**320**	**320**	**185**	**320**	**320**	**320**	**320**		
Season of Use	**6/15-10/15**	**6/15-10/15**	**6/15-10/15**	**7/1-10/15**	**6/15-10/15**	**6/15-10/15**	**6/15-10/1**		
Animal Months	**1280**	**1280**	**740**	**1120**	**1280**	**1280**	**1120**		

Attach analysis tabulations, calculations, and reports showing condition class, and maps. Make cross-reference to or include other data such as range inspections, administrative studies, climatic records, research publications, periodic utilization checks, production studies, and plant development measurements.

Miscellaneous information (recommendations: special problem areas, relationship to Forest Plan, etc.)

Map Label	Acres	Trend	Resource Value Rating	Forage Allowable Use %	Forage Production (dry lb/ac)	Est. Carrying Capacity (AUM)
6SA ABLA-PIEN	1205	↔		10%	300	35
6UA ABLA-PIEN	2115	↔		--	--	--
10SA POTR	1640	↔		40%	450	289
4SA QUGA/POPR	1278	↔		30%	500	188
4SU ARTR2/POPR	1680	↓		30%	525	259
2SU POPR/TAOF	518	↓		30%	400	61
2SA DECE-CANE2	285	↔		45%	925	116
2SU POPU9/DECE	113	↔		30%	900	30
2SA SAGE2/CARO5	135	↔		45%	1175	70
2SA CANE2	92	↔		45%	925	38
1SA FETH-FEID	625	↔		45%	750	207
1SA FETH-STLE4	820	↔		35%	725	204
1SA DAIN	217	↔		45%	850	81
Totals	10,723					1,578

5. Divide by 30 days/month to get estimated capacity figure in AUMs.

6. The estimated capacity *must* be checked against stocking rates on nearby allotments with similar characteristics and objectives before use is permitted. Initial capacity estimates should be conservative, allowing for the many other uses and values on public land.

7. Monitor actual use and adjust stocking as needed to meet objectives.

Livestock weights are average mid grazing season weights. Length of time on National Forest or Grassland range, breed of livestock, and when the animal is born can result in figures different from the averages listed. Big game are fall-season averages.

Table 3-5. DAILY FORAGE CONSUMPTION RATES

Kind and Class of Livestock	Animal Unit Factor	Daily Dry Weight Consumption	
		lbs	**kg**
Cattle[4]			
1000-lbs (454 kg) animal	1.000	26	11.79
Dry cow	1.000	26	11.79
Cow with calf	1.308	34	15.42
Yearling	0.692	18	8.16
Weaner	0.500	13	5.90
Bull	1.500	39	17.69
Bison	1.000	26	11.79
Horse	1.192	31	14.06
Sheep			
125-lbs (57 kg)	0.192	5	2.27
Ewe with lamb	0.308	8	3.63
Big Game[5]			
elk 430-lbs (195 kg)	0.462	12	5.44
deer 135-lbs (61 kg)	0.173	4.5	2.04

[4] Valentine, John F. Nutrient Requirements of Beef Cattle, Fifth revised edition. Committee on Animal Nutrition, National Academy of Sciences -- National Research Council. San Diego, CA: Academic Press, Inc. 1990.

[5] Personal communications: Colorado State Univeristy and Colorado Division of Wildlife Research Unit personnel.

TREND DETERMINATIONS

Trend is basically a measure of management's effectiveness in meeting allotment objectives for desired plant communities. Trend is described as toward, static, or away from objectives. Trend determinations are a key part of rangeland monitoring. An in-depth discussion of trend determinations can be found in the Monitoring Chapter (Chapter 4).

Field data collection should include re-sampling permanent trend plots. Trend should be estimated from either permanent plots or a recording of apparent trend based upon the observer's professional opinion. It is important to document whether trend determinations were measured or estimated. Major management changes involving considerable investments of time, funding, or livestock adjustments should be based primarily on measured trend studies at permanent locations.

ALLOTMENT MAP STANDARDS

There are two maps: the inventory map and the allotment map. Allotment maps are updated with every re-analysis of the grazing allotment. Until GIS technology is available, final allotment maps will be prepared according to the following standards.

Allotment maps throughout the Region will be similar in design, content, and appearance. Consistency can be obtained by utilizing the Regional Geometronics Photo Lab to prepare the base maps. Analysis information can be drafted onto the base maps by the person(s) completing the analysis. The following steps should be followed in the preparation of the base map:

1. Allow approximately three months for the preparation of the base map. Contact the Lab Director (303-275-5338) prior to ordering maps; establish time frames, map content, and costs. This contact is extremely important to insure that the Lab understands your needs and expectations.

2. Complete a Photographic Work Requisition (FS-7100-41) and submit it to the Photo Lab. This form should contain a short narrative requesting preparation of an allotment base map to regional standards. Any special instructions or expectations should be included in the narrative. Attached to the requisition should be:

    a. Forest Recreation Map or standard USGS Quad Map with the allotment boundary delineated. The area outside the allotment to be included in the base map

should also be delineated. A completed FS-7100-41 is included and Figure 3-3 shows the associated map.

b. Topographic map positives at the standard 1:24,000 scale for each USGS quadrangle within the allotment. Topographic positives are available on most Districts and in all Supervisor's Offices. Positives will be returned to the requesting unit when the map is complete.

c. The Photo Lab has the standard regional map symbols legend for the title block that will be attached to every map (Figure 3-4). Additions or deletions to the regional legend should be made by the ordering unit and submitted to the Lab. A title block should also be prepared by the ordering unit and submitted with the requisition. All additions to the legend, and the title block should be prepared with the same quality and format as the exhibits.

3. The Photo Lab will prepare a negative and a matte film positive of the allotment. The negative will be kept by the Photo Lab for future use, and the positive returned to the requesting unit. The positive will be used as the base map upon which analysis information is drafted. Analysis information can be drawn on the positive itself, or drafted on overlays. Allotment maps can be produced for field use on several types of copy machines. Figure 3-5 shows an example of a complete standard allotment base map.

4. For ease of map interpretation, the final allotment map will be colored using the standard rangeland cover type colors as defined on page 3-30.

FORM FS-7100-41

USDA-FOREST SERVICE	CHARGE TO (Unit): Red Cloud RD Headwaters NF	APPROPRIATION AND PROJECT: MC:664287	
PHOTOGRAPHIC WORK REQUISITION	SEND TO: R-2 GEOMETRONICS Photo Lab	ADDRESS: 740 Simms Lakewood, Co 80225	DATE DESIRED: 4/1/94
Instructions: Prepare field orders in accordance with local instructions. See FSM 7140 for orders to W.O.	ORDERED BY (Signature)	TITLE Support Services Supervisor	ORDER DATE: 12/15/9
	FOR INFORMATION (Name & Phone No.) M.Bovine 303-287-2635	ORDERING OFFICE REFERENCE (What & Date)	REQUISITION NO. 65

CLASS OF WORK	NO. COPIES DESIRED	SCALE	NEGATIVE NUMBERS, DESCRIPTION OF WORK AND SPECIAL INSTRUCTIONS	NEG./ORIG. SENT	NEG./ORIG. RETURN
Aerial index					
Aerial mosaic					
Aerial photo (Contact-Enlargement)					
Autopositive					
Blue-line prints					
Blueprints					
Color proof					
Contact prints					
Diapositive plates					
Diazo					
Diazo reproducibles					
Duplicate slides (35 mm)					
Enlargements					
Field photography					
Film developing					
Film positives	1	1:24000	This requisition is for the		
Line film			preparation of a Matte Film Positive		
Map mosaic			of the Turret Peak C&H Allotment.		
Microfilm print					
Mounting			Attached is a Forest Map of the		
Multilith			area to be included on the		
Opaque plastic prints			positive. Also attached are the		
Paper negative			topographic map positives to be		
Photostat prints			used in constructing the Matte Film		
Polyester			Positive. Please return these topo		
Reductions			map positives upon completion.		
Scribe coating					
Solar bromide prints					
Transparencies					
Vandyke neg. or pos.					
Watercote					

Photographic Laboratory Record — DATE PROMISED — DATE SENT

CLASS OF WORK	NO. COPIES	TOTAL NO. COPIES	SIZE	UNIT COST	TOTAL COST	MONTH BILLED

Accounting Data for Use by Ordering Office — ESTIMATED OBLIGATION:

APPN. (F. S.)	STATE	ACCOUNT OR ACTIVITY	FUNCTION Major	FUNCTION Sub.	FUNCTION Exp.	PROJECT	SPECIAL LIMITATION	OBJECT CLASS Major	OBJECT CLASS Sub.	OBJECT CLASS Rate	AMOUNT

Figure 3-3. SAMPLE MAP

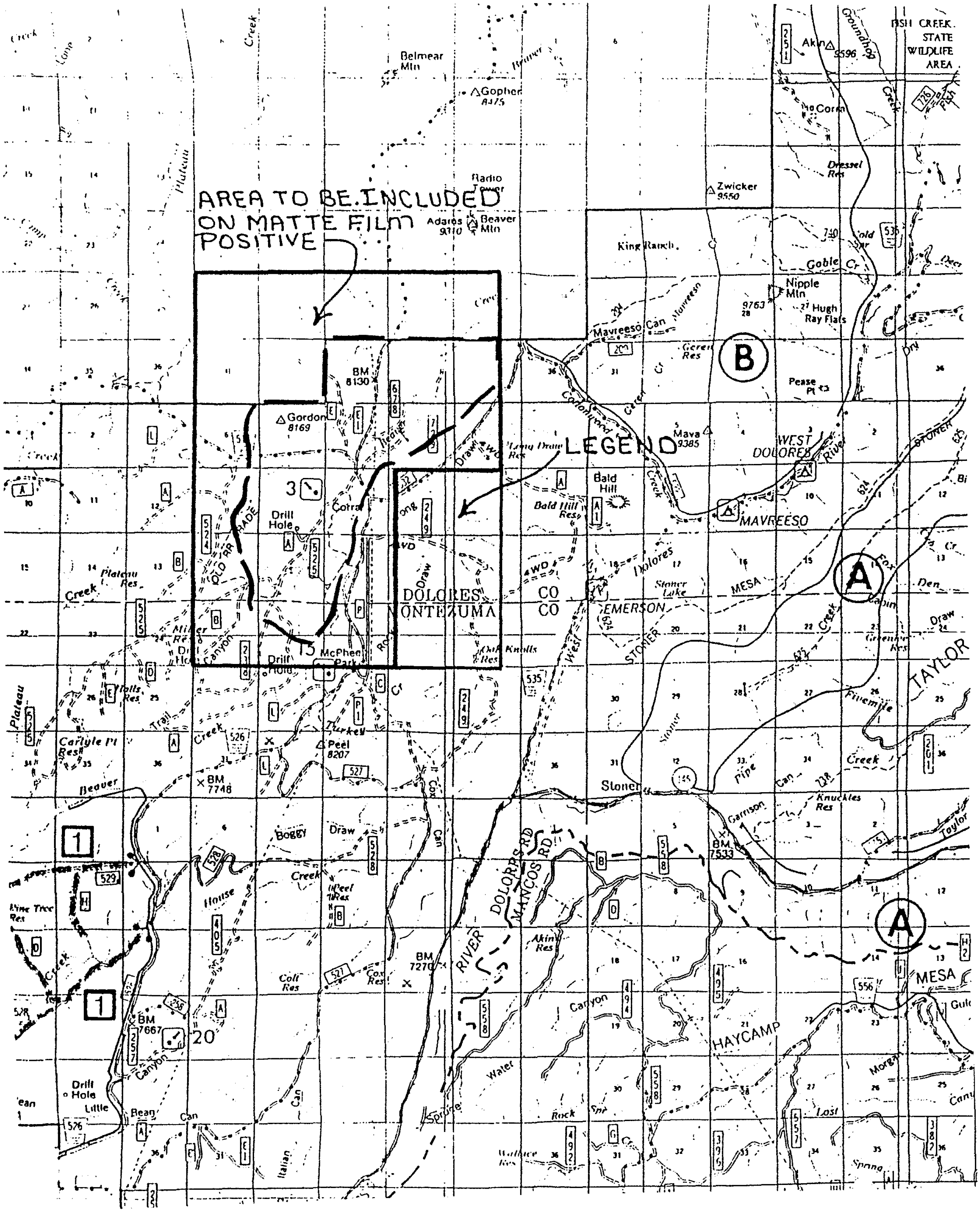


Figure 3-4.

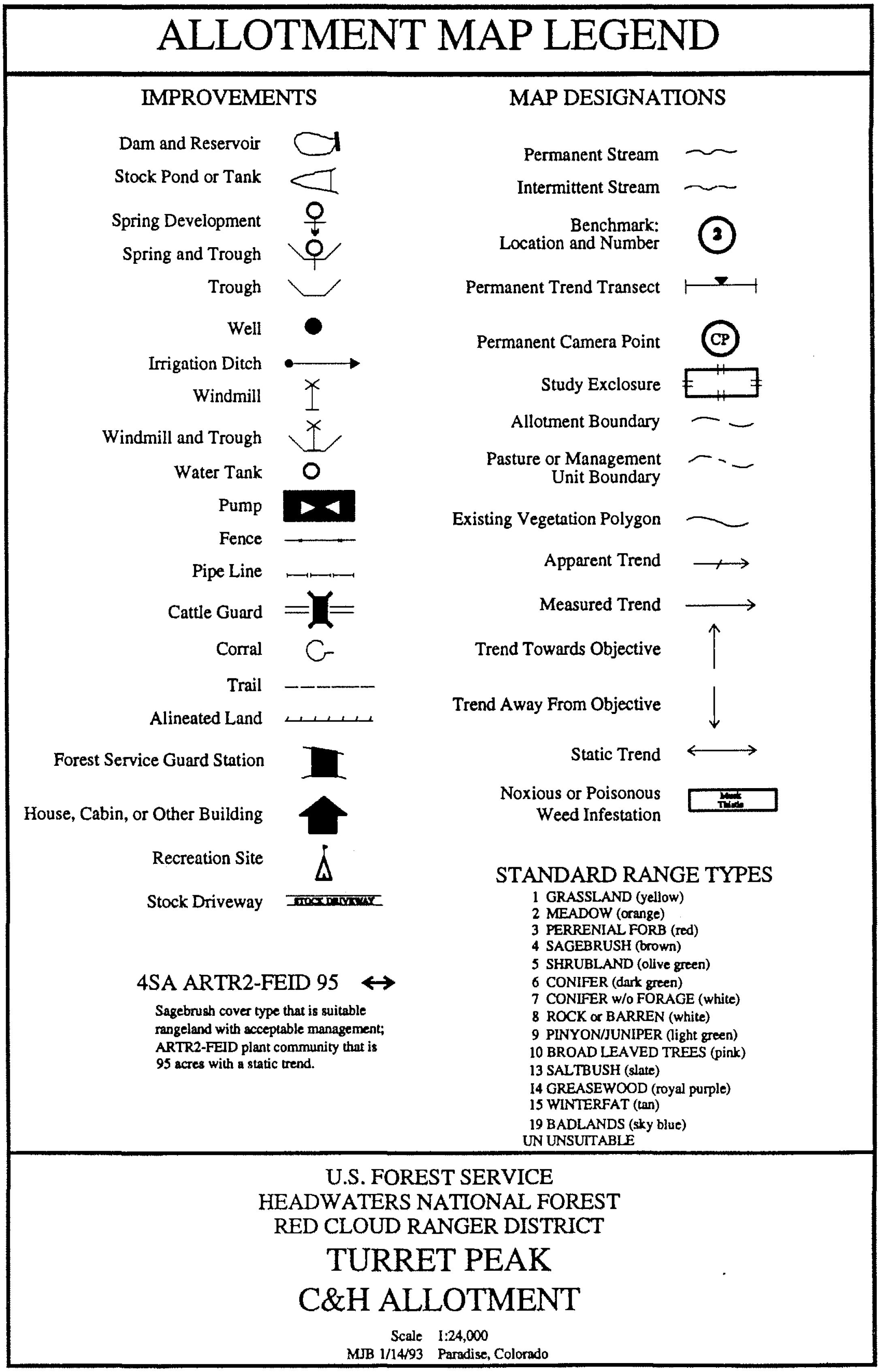
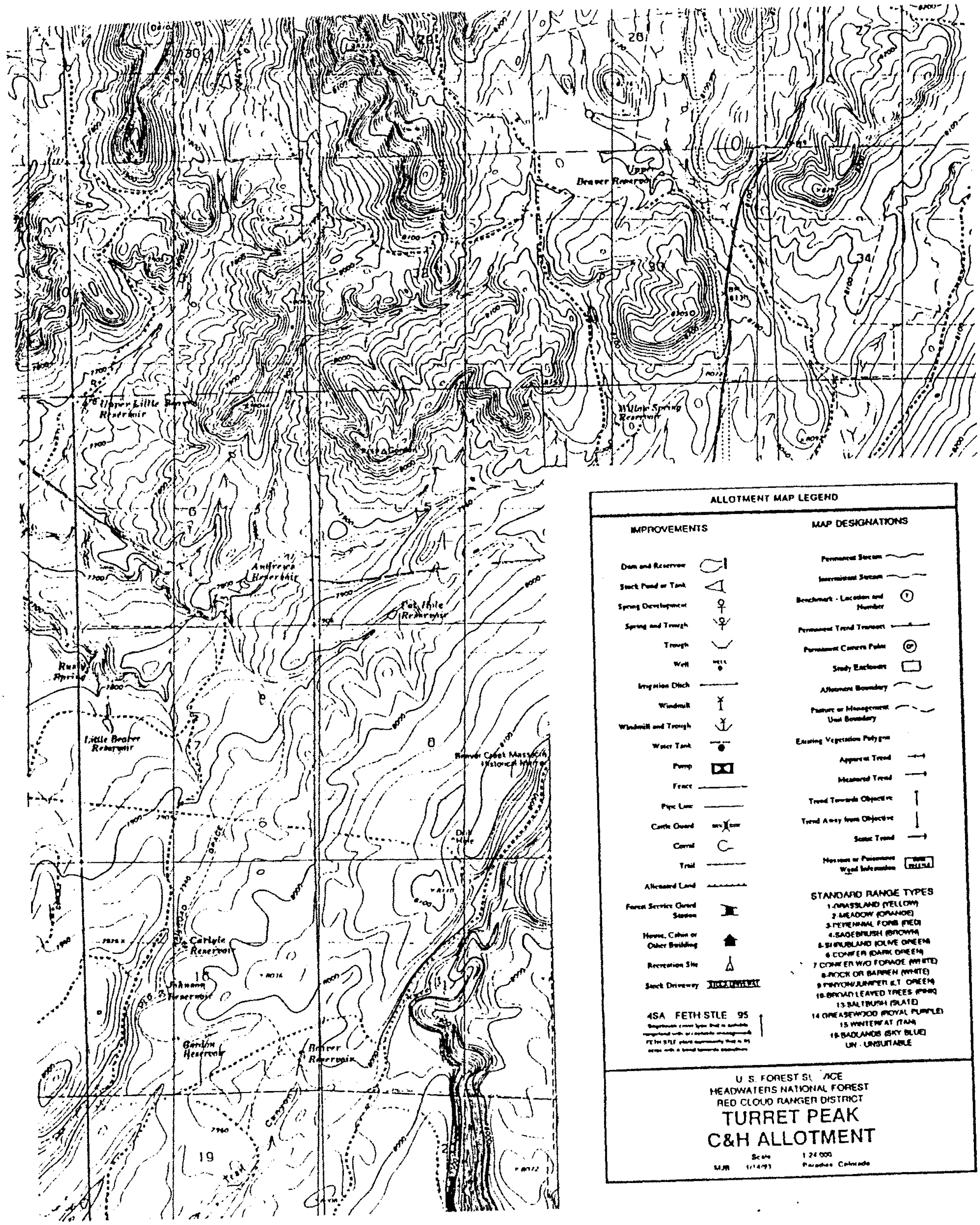

ALLOTMENT MAP LEGEND
IMPROVEMENTS
Dam and Reservoir
Stock Pond or Tank
Spring Development
Spring and Trough
Trough
Well
Irrigation Ditch
Windmill
Windmill and Trough
Water Tank
Pump
Fence
Pipe Line
Cattle Guard
Corral
Trail
Alineated Land
Forest Service Guard Station
House, Cabin, or Other Building
Recreation Site
Stock Driveway
STOCK DRIVEWAY
4SA ARTR2-FEID 95
Sagebrush cover type that is suitable rangeland with acceptable management; ARTR2-FEID plant community that is 95 acres with a static trend.
MAP DESIGNATIONS
Permanent Stream
Intermittent Stream
Benchmark: Location and Number
2
Permanent Trend Transect
Permanent Camera Point
CP
Study Exclosure
Allotment Boundary
Pasture or Management Unit Boundary
Existing Vegetation Polygon
Apparent Trend
Measured Trend
Trend Towards Objective
Trend Away From Objective
Static Trend
Noxious or Poisonous Weed Infestation
Musk Thistle
STANDARD RANGE TYPES
1 GRASSLAND (yellow)
2 MEADOW (orange)
3 PERRENIAL FORB (red)
4 SAGEBRUSH (brown)
5 SHRUBLAND (olive green)
6 CONIFER (dark green)
7 CONIFER w/o FORAGE (white)
8 ROCK or BARREN (white)
9 PINYON/JUNIPER (light green)
10 BROAD LEAVED TREES (pink)
13 SALTBUSH (slate)
14 GREASEWOOD (royal purple)
15 WINTERFAT (tan)
19 BADLANDS (sky blue)
UN UNSUITABLE
U.S. FOREST SERVICE
HEADWATERS NATIONAL FOREST
RED CLOUD RANGER DISTRICT
TURRET PEAK
C&H ALLOTMENT
Scale 1:24,000
MJB 1/14/93 Paradise, Colorado

Figure 3-5. ALLOTMENT MAP (SCALE 1:24,000)



ALLOTMENT MAP LEGEND

If the IRI is complete for the area being analyzed, then the rangeland inventory will validate, refine, and update the CVU layer. Any identified changes must be coordinated through the Forest IRI leader and will be incorporated directly into the electronic CVU layer.

If the CVU layer has not been developed through an Inventory Center for the allotment(s) being inventoried, then a rangeland inventory will be conducted following Integrated Resource Inventory guidelines as closely as possible. The intent is to develop an interim map that will facilitate the IRI process later.

In either case, it is likely that information additional to that available through the CVU layer will be required on the allotment map. The allotment map must be useful to resource managers and permittees alike, at the project level. Several important pieces of information often included on the map are listed below.

These guidelines are intended to serve during the transition period between traditional rangeland analysis and implementation of new GIS and IRI technologies.

Standard Rangeland Cover Types

Use the following number and color codes to indicate the rangeland cover types. Labeling and coloring the map will often be done by hand, at present. In the future GIS technology will produce maps with the same numbering and coloring conventions. Or, the conventions may be easily modified, as warranted.

1.	Grassland	yellow
2.	Meadow	orange
3.	Perennial forb	red
4.	Sagebrush	brown
5.	Browse -- mountain shrub	olive green
6.	Conifer	dark green
7.	Conifer without forage	[no color]
8.	Rock or barren	[no color]
9.	Piñon juniper	light green
10.	Broad-leaved trees	pink
13.	Saltbrush	slate
14.	Greasewood	royal purple
15.	Winterfat	tan
19.	Badlands	azure-sky blue

Range Suitability

Range suitability is expressed as either:

S (suitable), or
U (unsuitable).

Vegetation Management Status

Vegetation management status is expressed as either:

A (acceptable), or
U (unacceptable).

Common Vegetation Unit

There are two naming conventions of which one or both may be used on the allotment map.

1. The map unit legend will be as described in the Common Vegetation Unit Chapter of the IRI Training Guide, including physiognomic class, species, size, density, crown condition, vertical structure, and horizontal structure.

2. In the absence of a common vegetation unit map, a plant community name may be used. The name is usually two (sometimes three) species, with usually one identified per layer, that are the most abundant in the existing vegetation. For example, *Artemesia tridentata—Festuca idahoensis* (ARTR2-FEID).

Acres

The number of acres included in the map unit.

Trend

Use symbols from Table 3-6 to indicate trend.

Table 3-6. TREND SYMBOLS

Trend	Symbol
Toward	↑
Static	↔
Away From	↓
Not Apparent	?

The six items listed above are the minimum required to adequately label the range allotment map. A sample allotment inventory map unit label will look like:

4SA ARTR2-FEID 95 ↔

This indicates a sagebrush cover type that is suitable rangeland with acceptable ve... management status. It is the ARTR2-FEID plant commu... and the 95 acres in the map unit have a static trend with respe... meeting management o... tives.

There are two additional items which ... added to the map label, if the information is available. They are:

Ecological Type

Ecological types commonly use a two-part name including abiotic and biotic information. The abiotic portion is based on physical features such as landform or soil family. The biotic name consists of two (s... s three) scientific names of characteristic, prominent... stic species. (The Common Land Unit map legend ma... natively used instead of the ecological type name.)

1. Where the ecological type is only one layer of vegetation, one or two species names will be used. For example, *Agropyron smithii—Stipa viridula.*

2. Where the ecological type is more than one vegetation layer, species names will be used from both (or all) layers. For example, *Pinus ponderosa / Purshia tridentata / Festuca idahoensis.*

3. An example of a complete ecological type name might be *Pinus ponderosa / Purshia tridentata / Festuca idahoensis*—Typic Cryoboraolls, fine-loamy, mixed or *Artemisia tridentata / Purshia tridentata / Festuca idahoensis*—Typic Cryoboraolls, fine-loamy, mixed.

Ecological Status

The ecological status is indicated by PNC, LS, MS, or ES.

INVENTORY METHODS

There are three categories of information collection methods related to rangeland inventory. First are regionally standard inventory methods for collecting information about and describing vegetative characteristics. Second are additional methods which may be developed locally. Third is support data, *which is required* for all inventory and monitoring samples.

The most frequently used methods for vegetative inventory in the Rocky Mountain Region, in order of increasing intensity, are ocular plant composition, cover-frequency, and line intercept. Data collected by these methods can be used for:

1. classification of ecological types,
2. community type descriptions,
3. predicting vegetation response to treatment,
4. developing resource value ratings,
5. calculating similarity to desired plant community or to potential natural community, and
6. monitoring change over time (except for ocular plant composition method).

STANDARD INVENTORY METHODS

Ocular Plant Composition Method (OP)

This method is used to expand the sample size and allow the examiner to more thoroughly inventory all portions of a polygon. The sample is usually a 0.10 acre or 0.20 acre circle, with canopy cover estimates for each species present. The ocular plant composition method is described on page 3-43. This method is identical to the process used by IRI.

Cover-Frequency Method (CF)

This is the primary rangeland inventory method used in this Region. It provides both canopy cover and frequency of occurrence for plant species. The sample is a 100-foot transect with canopy cover measures developed from twenty Daubenmire plot frames placed at 5-foot intervals along the transect line. Cover-frequency samples can be used for long-term monitoring, when they are permanently established. The cover-frequency method is described on page 3-57.

Line Intercept Method (LI)

This method is used to measure canopy cover of shrub species. The sample is a 100-foot transect with actual occurrence of foliar shrub cover measured to the nearest 0.10 foot. Line intercept samples can be used for long-term monitoring, when they are permanently established. The line intercept method is described on page 3-73.

Shrub Density (SD)

This method is used to collect information on maturity and form classes for individual shrub plants, as well as degree of hedging. This method is used in conjunction with line intercept transects. The shrub density method is described on page 3-87.

Production Data (PD)

A key element of initial inventory is collection of vegetative production data. Production information is useful for making general decisions regarding plant community health and vigor. Additionally, production is a necessary element in determining carrying capacity for grazing animals. The production data method is described on page 3-95.

Parker Three-Step Method

The Parker three-step method is not an approved method in the Rocky Mountain Region. However, as many as possible should be converted to cover-frequency transect data. It is recommended that location of Parker three-step transect clusters be evaluated and if appropriate, converted to cover-frequency transects. See page 3-111 for a more complete discussion of converting Parker transects to cover-frequency.

OTHER METHODS

Other inventory methods may be employed in addition to the standard region-wide methods for vege[illegible]entory listed above. Forests are encouraged to adopt sta[illegible] sound methods, if available. For example, Uresk[6] describes a technique using discriminate and cluster analysis for classifying rangeland ecosystems into ecological stages on the basis of cover and frequency estimates of only a few vegetation species.

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[6]Uresk, Daniel W. 1990. Using Multivariate Techniques to Quantitatively Estimate Ecological Stages in a Mixed Grass Prairie. J. Range Manage. 43:282-285.

Currently there is an on-going interagency project to develop a series of inventory and monitoring technical guides for use by all agencies. These technical guides will include all the methods in this Guide, plus additional methods for use in specific locations and situations in the western United States. Any of the methods in the interagency technical guides are approved for use in the Rocky Mountain Region. The technical guides are anticipated to be available by the 1995 field season.

In order for a Forest to use another method, it must be published and subjected to peer review, and be approved by the Regional Forester.

SUPPORT DATA

General Field Form (GF)

This form is required as an integral part of information gathering, regardless of the inventory or monitoring method used. This form must be completed for all samples: temporary and permanent. General field data has wide utility to many applications, not just rangeland inventory and analysis. It can be used to stratify District, Forest, and Regional data bases, as well as a basis for extrapolating information to other sites with confidence. The absence of general field data weakens the utility of the data for other purposes. The general field form is described on page 3-113.

Normally, a General Field Form must be completed for each and every sample. The only exception where one General Field Form can be used for several plots is when more than one transect for cover-frequency and/or line intercept are clustered together -- similar to the way Parker three-step transects were clustered.

Rangeland Health Evaluation Matrix (RH)

This form is used to generally characterize the health of the rangeland.[7] It is useful in orienting the examiner's eye towards characteristics and features which are important in managing rangeland ecosystems. This form is normally completed as part of every sample. The rangeland health evaluation matrix is described on page 3-175.

[7] Rangeland Health: New methods to classify, inventory, and monitor rangelands. National Academy Press, 1994.

Comments Data Form (CD)

This form is used to record any comments for a plot, transect, or polygon as the need arises. Important observations not recorded on other forms should be noted. Clarification of non standard conditions or data codes is documented on this Form. The Comments Data Form is described on page 3-176.

TIMING OF SAMPLING

Installation, measurement, and remeasurement of all samples should be timed to coincide with maximum phenological development. This helps in plant identification and also reduces variation in canopy cover estimates. Where possible sample prior to grazing. When planning remeasurements keep in mind the stage of phenological development rather then calendar dates.

LOCATION OF TRANSECTS

The objective of proper transect location is to randomly select a site which is representative of existing conditions or of the desired plant community. Sample plots must be located within definite boundaries of the common vegetation unit to be described. They must be placed on representative and uniform sites so that ecotones are avoided.

Temporary transects should be located in the key area based upon the professional judgment of the rangeland manager. For permanent transects to be used for trend measurements for many years, special care must be taken to eliminate bias in location. It is advisable to utilize a grid system in locating the benchmark where the transect will be located.

NUMBER OF TRANSECTS

Regardless of the method(s) selected for conducting the inventory, the examiner will have to rely on common sense, professional judgment, and statistical reliability to determine the number of transects required to adequately describe the common vegetation unit. Reference Appendix C for the procedure to determine the appropriate number of transects necessary to describe the variability of the site. Parameters such as intensity, controversy, and the magnitude of the decision to be made will determine the number of sample sites.

It is preferable to record more transects than to increase the number of sample points on a single transect. This is especially critical in sparse vegetation or plant communities that are patchy in occurrence. After completion of the first transect, walk around the site and determine whether the site is adequately sampled. If

more transects are needed, be sure they are at least 50 feet apart and parallel, if possible.

ESTABLISHING TRANSECTS

Permanent or temporary transects can be used with all of the sampling methods. ***Regardless of transect duration, permanent vs. temporary, all plot or transect locations must be marked on maps and/or aerial photographs.*** The location of all transects should be sufficiently described for easy of relocation, including road or trail log, reference point description, distance and bearing to the plot from the road or trail, and plot center description. The location should be labeled with the plot number.

Temporary transects are adequate for most inventory purposes, but permanent transects are recommended for benchmark areas where trend of the ecological unit will be monitored over time. Temporary transects are established identical to permanent transects except that there are no permanent stakes. ***Paced transects are not approved for collecting canopy cover and frequency data.***

A common problem related to permanent transects is that too many are initially established and eventually resources may not be available to do an adequate job of remeasurement for monitoring purposes. Keep in mind the intensity needed and the reasons for monitoring when making decisions about number and placement of permanent transects. Also recognize that establishment of permanent transects does not automatically mandate frequent and regular remeasurements. Remeasurement intervals may be decades, or even unknown. Relocation of photo locations from the turn of the century is an example of a "remeasurement."

MARKING AND DOCUMENTING PERMANENT TRANSECTS

Locate permanent transects so they are effective in evaluating change over time. A key item to remember when installing a permanent transect is the ease of relocating the transect in the future. The following items should be addressed during installation:

1. Locate transect locations on the allotment map and pin-prick aerial photos. Describe the transect location on the back of R2-2200-PH for all methods, including road or trail log, reference point description, distance and bearing to the plot from the road or trail, and plot center description.

2. Use GPS (Geographic Positioning System) technology where possible to identify transect location.

3. Always mark the 0.0 foot and the 100.0 foot ends of the transect, or center point of the ocular plot, with a metal stake. The stake can be either 1-inch angle iron or 1/2-3/4 inch re-bar. Aluminum survey caps with imprinted transect numbers may be considered for marking the transects. Paint the metal stake with yellow or orange paint to make it easier to find. It is also a good idea to paint a 6-8 inch rock and place it against the stake. This helps protect it from disturbance and also make the transect much easier to relocate.

PLANT IDENTIFICATION SKILLS

All methods require that inventory crews be able to identify the vegetative species encountered in the plots. Range conservationists/technicians, wildlife biologists, foresters, soil scientists, ecologists, and other personnel involved in inventory of rangelands should be able to visually identify all species in the area. The inventory crew should also have available, and be able to use, reference material to properly identify all other vegetative species encountered.

Some of the more obscure plants may play a vital role in detecting trend. Identification of *all* vegetation encountered in the plots will prove critical to Integrated Resource Inventory, soil surveys, biodiversity assessments, Forest planning, and ecological classification efforts. Plant identification can be enhanced through self-study. All employees should be familiar with at least 25 of the local predominate graminoid species, 50 forb species, and 15 shrub species through plant collection or herbarium study. References recommended for self-study are listed in Appendix D.

PHOTOGRAPHS

The following guidelines are universal for all sampling methods. Use these guidelines to insure the highest quality photographs and documentation.

1. It is preferable to use a good quality 35mm camera with a 28mm wide angle lens. However, many of modern compact automatic 35mm cameras will take good quality photographs suitable for monitoring purposes. Use color slide film (avoid Ektachrome film because colors tend to wash out due to ultraviolet light). Slide film is superior because good quality prints can be made from the slides, and the slides are still available for presentations.

2. Record information on the Comments Form (R2-2200-CD) as necessary regarding the lens size, photo direction (bearing), camera settings, and film speed. This is especially important for photographs that have a high probability of being included in a publication.

3. Pictures will be identified by placing symbols in chalk on a small blackboard, or by using Form R2-2200-PH (Appendix I) for transect photo identification which will be visibly displayed in the picture. For the 3 feet by 3 feet plot, the blackboard should be placed just behind the plot, and for the general view, alongside the tape.

4. Make notes on the R2-2200-CD Form which will help to identify the vegetation in the picture and other conditions worthy of note. Photo information is a permanent part of the transect record.

Photographing Ocular Plant Composition Samples

Photo records of ocular plots should capture the essence of the plot. Take as many photos as necessary to characterize the site.

1. Take a close-up photograph as described in Photographing Transects, number 2 (page 3-40). This photograph should be taken standing at the plot center and facing up-slope. It is not necessary to set the camera at the specified 42 inches; the examiner can hold it at eye level. Use the 3 feet by 3 feet square formed by the carpenters rules, or some other indicator of scale in the photograph.

2. Four additional photos should be taken -- one at each of the cardinal directions (Figure 3-6). These photos are to depict

the landscape. Each photograph should be framed so that the area above the horizon fills one-fourth or less of the photo frame.

Photographing Transects

Two photographs will be taken before reading the transect to show undisturbed vegetation. One photograph will be a close-up shot and the other a general view along the transect line (Figure 3-7). Photographs are inexpensive permanent records of any plot. Examiners should not hesitate to take as many pictures as are deemed necessary to capture important characteristics and features of the site.

1. Photographs will be taken from over the 0.0 foot stake, in the direction of the transect. The camera should be set up at an approximate height of 42 inches directly over the point, or high enough to include the entire 3 feet by 3 feet close-up plot, and Form R2-2200-PH or the identification board.

2. The 3 feet by 3 feet plot will be established, using 6-feet folding carpenter rules (white) so the near edge is 3.5 feet from the stake and the far edge 6.5 feet from the stake. It is helpful to clip the rules together so that they will stay in place. Lay the carpenter rule frame on top of the transect tape.

3. The general view will be taken down the transect line and should be focused at 20 feet. Pictures will appear neater if some sky is shown (20 percent or less of the picture). For best results, take pictures when the light is coming from the left or right of the camera (side lighting). Use a lens hood (sunshade) if available. Use as small an aperture and correspondingly slow shutter speed as possible, so depth of field is maximized.

4. Benchmark clusters will be numbered consecutively for each allotment. Transects will be numbered consecutively for each cluster. This numbering should be unchanged once it is established. The symbols should clearly show in the picture and not be obscured by vegetation.

Figure 3-6. OCULAR PLANT COMPOSITION PHOTOGRAPH LAYOUT

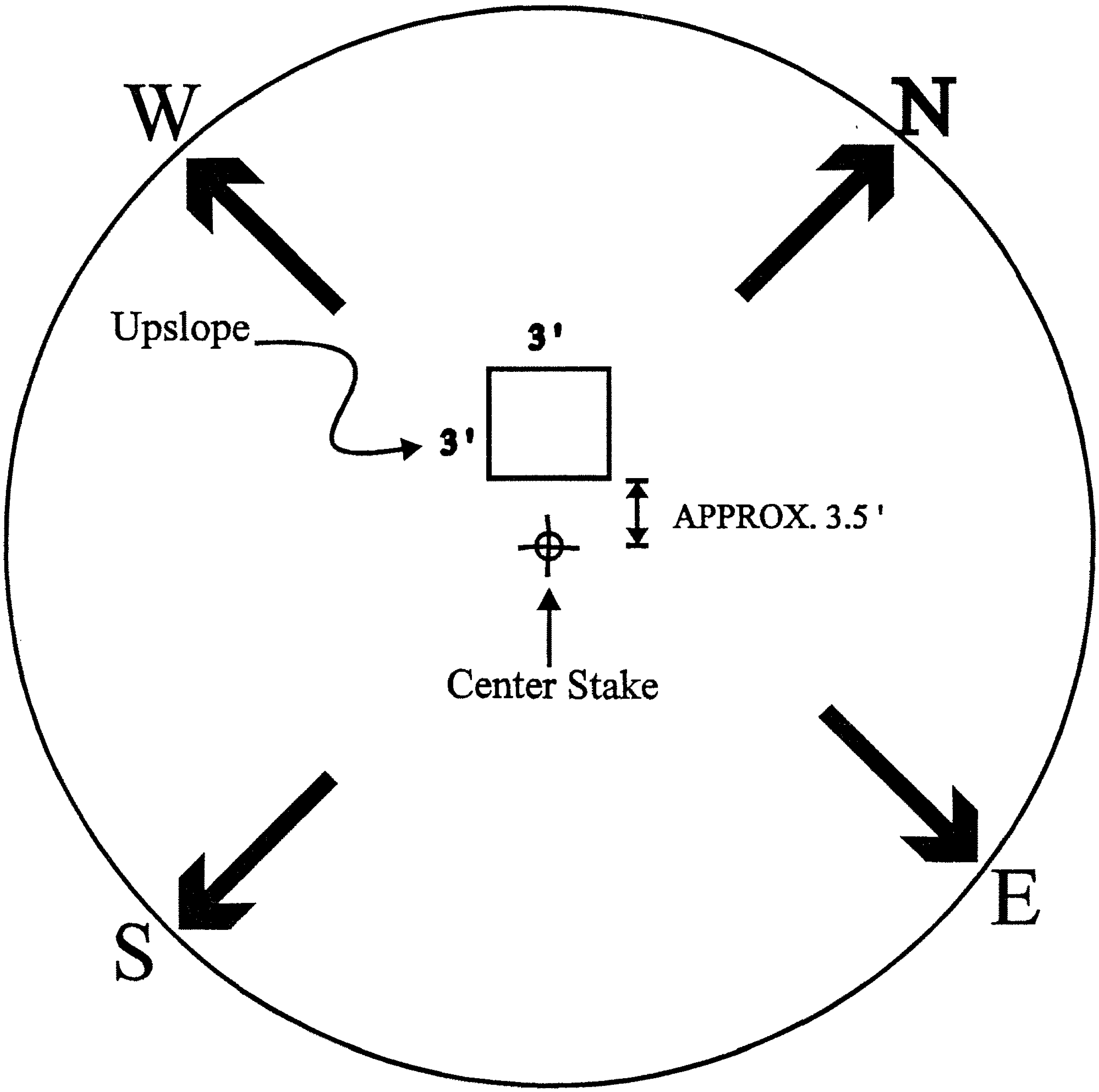
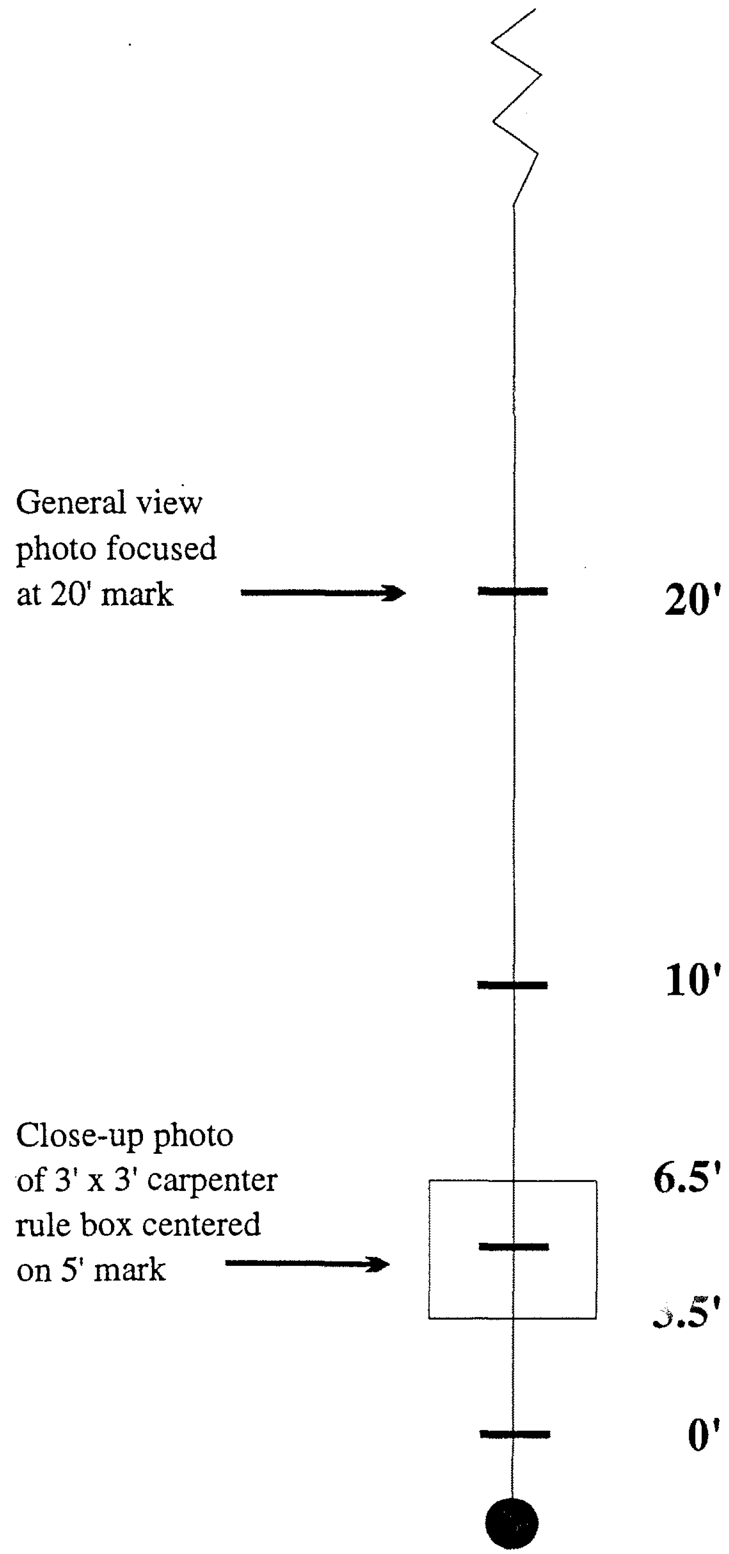


Figure 3-7. COVER-FREQUENCY PHOTOGRAPH LAYOUT



OCULAR PLANT COMPOSITION DATA
R2-2200-OP

GENERAL DISCUSSION

This sampling method is used to describe ocular estimates of plant species canopy cover, height, shrub form class, phenology, and utilization. It is the primary method used for plant composition. Both full and reduced species lists are accommodated by this method. This method is fairly simple to conduct in the field. It is relatively fast and therefore lends itself to many samples over large areas.

Calibration of ocular estimates should be conducted at the outset of inventory projects and occasionally (usually every 5 - 10 ocular plots) during the project. The examiner must calibrate ocular estimates by using line intercept method and/or cover-frequency transect method.

ADVANTAGES AND LIMITATIONS

The ocular plant composition method is adapted to areas where inventory data must be obtained over large areas using few examiners. It can be used to expand the sample size within a polygon or allotment as a supplement to cover-frequency transects. The ocular plant composition method is rapid and is a good method to use in communities with tall shrubs or trees.

TRAINING

Examiners must be knowledgeable in plant identification. It is relatively easy to learn to estimate canopy covers to the nearest percent. Examiners usually calibrate their ocular estimates by periodically double sampling with cover-frequency transects. Variability between trained examiners on canopy cover estimates is usually minimal and is negated by the large number of samples that can be obtained with this method.

PERSONNEL AND EQUIPMENT

Required equipment includes a 100-foot tape (marked in feet and tenths of feet), stakes for temporarily marking the ocular plot perimeter, flagging, and a camera. Two forms must be completed for the ocular method: General Field Data Form (R2-2200-GF) and Ocular Plant Composition Data Form (R2-2200-OP).

SAMPLING PROCEDURE

The plot is typically 0.10 acre in size and must be located within a representative and uniform portion of the vegetation and site conditions being described. This means that the plot should not cross ecotones of either vegetation or site conditions, and should be representative of the general treatment or management use practiced on the area to be described. However, in some cases the plot may be located to sample vegetation and site conditions within ecotones that are fairly broad.

The ocular plant composition plot is a circular plot with a radius of 37.25 feet and an area of 4,356 square feet (0.10 acre). Mark the center of the plot and then measure and flag the outside edge of the plot. Place flagging or metal pins upslope, downslope and along the contour (left and right of plot center). See Figure 3-8 for a diagram of the ocular plant composition plot boundary.

Once the boundary of the plot has been delineated, walk around the plot and become familiar with plant species, ground cover, layering of vegetation (if trees and shrubs are present), and other ecological characteristics.

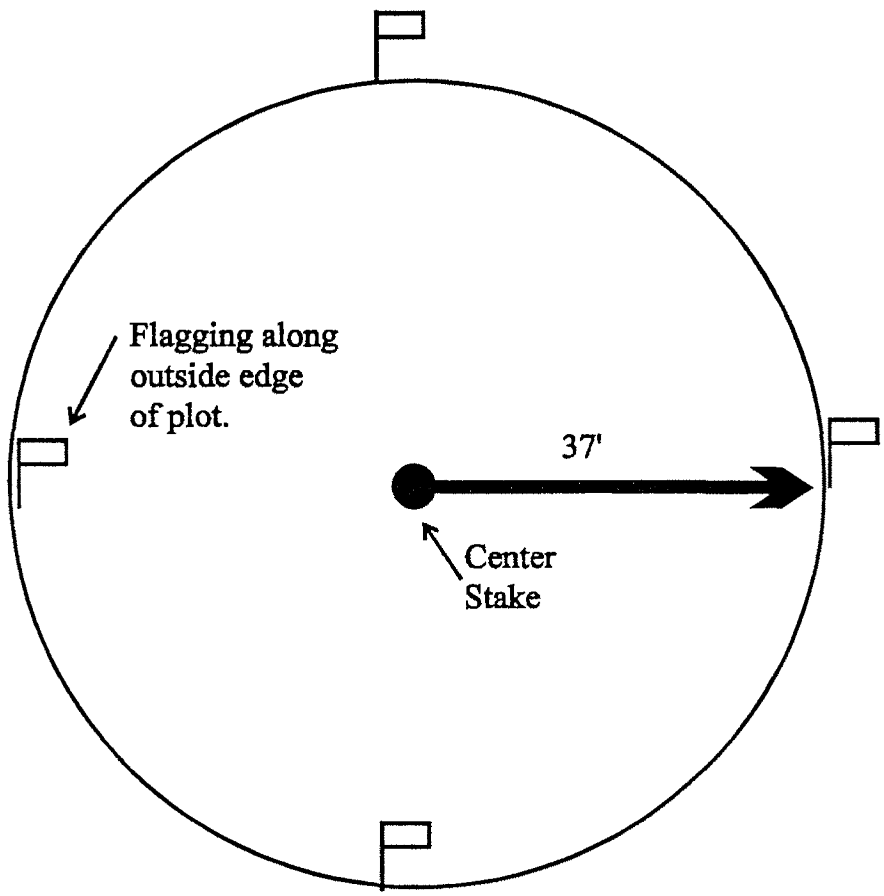
After examination is complete, return to the center of the plot and visually estimate percent canopy cover by species, and percent ground cover. Record observations on the Ocular Plant Composition Form R2-2200-OP.

FORM DESCRIPTION
R2-2200-OP

In completing this form, order species by life form groups. For example, enter all tree species at the top of the page followed by a blank line, and then enter all shrub species, skip a line and then enter all graminoid species, and so forth.

The field form allows for 70 plant species and 11 ground cover attributes to be recorded but you may enter as many species as needed into the data base. If you have more than 70 species on the plot, continue the list on another field form. A field-by-field description follows.

Figure 3-8. OCULAR PLANT COMPOSITION PLOT LAYOUT



FIELDS 1-7: PLOT IDENTIFIER (15-CHAR)

These fields constitute the Key ID for the plot and link the data base containing the General Field Data to the Plant Composition data base. Duplicate the key identifier here for the plot taken from the General Field Data (that is, fields 1-7 of Form GF). This field cannot be left blank during data entry.

Required.
Accuracy Standards = No Errors.

FLORA IDENTIFICATION SOURCE (4-CHAR)

This is a four-character code that identifies the source used to determine plant species identification. Synonyms are tracked through the SCS PLANTS data base. Use the following codes:

CODE	FLORA
B49	Bailey, 1949. Manual of cultivated plants most commonly grown in the continental United States and Canada.
B79	Bare, 1979. Wildflowers and weeds of Kansas.
B68	Barkley, 1968. Manual of the Flowering Plants of Kansas.
B69	Barrell, 1969. Flora of the Gunnison Basin.
BJ85	Brunsfeld & Johnson, 1985 Field guide to the willows of east-central Idaho.
C88	Carter, 1988. Trees and shrubs of Colorado.
C74	Colson, 1974. Polyclave key to the Colorado and Wyoming species of Carex.
CJ70	Correll & Johnston, 1970. Manual of the Vascular Plants of Texas.
C+84	Cronquist, et al., 1984. Intermountain Flora: Vascular Plants of the Intermountain West, USA.
D77	Dorn, 1977. Manual of the plants of Wyoming.
D88	Dorn, 1988. Vascular plants of Wyoming.
DD77	Dorn & Dorn, 1977. Flora of the Black Hills.
E76	Elmore, 1976. Shrubs and trees of the Southwest Uplands.
F93	1993. Flora of North America, North of Mexico.
GN86	Goodrich & Neese, 1986. Uinta Basin Flora.
H+87	Hallsten, et al., 1987. Grasses of Wyoming.
H54	Harrington, 1954. Manual of the plants of Colorado.
H70	Hermann, 1970. Manual of the Carices of the Rocky Mountains and Colorado Basin.
H76	Hermann, 1976. Manual of the rushes (Juncus spp.) of the Rocky Mountains and Colorado Basin.
HC50	Hitchcock & Chase, 1950. Manual of the Grasses of the United States.
HC69	Hitchcock & Cronquist, 1969. Key to [grass] species based upon vegetative characters.
HC73	Hitchcock & Cronquist, 1973. Flora of the Pacific Northwest.
J64	Johnson, 1964. Field key to the Sedges of Wyoming.
K87	Kindscher, 1987. Edible wild plants of the prairie: An ethnobotanical guide.
K70	Kirk, 1970. Wild edible plants of western North America.
LM85	Lampe & McCann, 1985. AMA handbook of poisonous and injurious plants.
MB77	McGregor, et al., 1977. Atlas of the Flora of the Great Plains.
M+86	McGregor, et al., 1986. Flora of the Great Plains.
M56	McKean, 1956. Winter guide to native shrubs of the central Rocky Mountains.
N74	Nelson, 1974. Vascular plants of the Medicine Bow Mountains, Wyoming.
N79	Nelson, 1979. Handbook of Rocky Mountain Plants.
P75	Pesman, 1975. Meet the natives.
S69	Stephens, 1969. Trees, Shrubs, and Woody Vines in Kansas.
S73	Stephens, 1973. Woody Plants of the North Central Plains.
V86	Van Bruggen, 1986. The Vascular Plants of South Dakota.
V69	Von Frieden, 1969. Mushrooms of the world.
W76	Weber, 1976. Rocky Mountain Flora.
W86	Weber, 1986. Colorado Flora: Western Slope.
W90	Weber, 1990. Colorado Flora: Eastern Slope.
W+87	Welsh, et al., 1987. A Utah Flora.
YY86	Young & Young, 1968. Geology and wildflowers of Grand Mesa, Colorado.

Required.
Accuracy Standards = No Errors.

PLANT IDENTIFICATION LEVEL (2-NUM)

Enter the percent canopy cover above which all plants are identified to species on the Ocular Plant Composition Form (R2-2200-OP). For example, "05" indicates that all plants with 5 percent canopy cover or greater are identified to species, "00" indicates that *all* plant species have been identified (that is, a full species list was collected). It is recommended 1 or 5 percent cover be used as the minimum identification level when sampling objectives require a reduced species list. Collect full species lists wherever feasible.

If you wish to note the occurrence of species which have cover values less than the plant identification level because their presence alone is of significance (for example, noxious weeds, habitat type indicator species, or threatened, endangered, or sensitive species) you may record these species on the field form.

Required.
Accuracy Standards = No Errors.

LIFE FORM (1-CHAR)

Use the following codes to describe the life form of each species.

CODE	LIFE FORM
T	tree (includes conifer and broadleaf trees)
S	shrub (includes woody stemmed vines and subshrubs)
G	graminoid
F	forb
E	fern/allies (includes *Lycopodium* and *Selaginella*)
M	moss
L	lichen
U	fungus
A	alga
Z	not applicable

Required.
Accuracy Standards = No Errors.

NOTE: Whenever a plant species code (or symbol) is required, use the 8-character alpha-numeric codes from the standard Soil Conservation Service's PLANTS data base. Lists of all species by state are available from the Forest botanist, ecologist, or soil scientist.

SPECIES (8-CHAR)

For vascular plant species, use the 8-character alpha-numeric code from the SCS PLANTS data base. Identify plants to species, if possible. For genus identification, enter the appropriate genus code (for example, "AGROPY" for *Agropyron* spp.).

Required.
Accuracy Standards = No error in species level identification for dominant, common, or habitat type indicator plants. 95 percent or more of the species with a canopy cover greater than or equal to the plant identification level specified must be accurately identified if adequate floral and vegetative characteristics exist, or at a minimum, identified to genus or life form. The examiner should request verification of questionable plant identifications from a person locally recognized for their ability to identify plants. No plant name should be repeated twice within a layer.

LAYER HEIGHTS

The following information provides structural information about the stand. To specify layers, mentally group individuals of each species into one of more layers. There can be multiple layers for each species as long as these layer breaks are logical and consistent. If clear layer breaks cannot be determined, do not split them out.

Use the following guidelines to determine naturally occurring layers in the stand. These guidelines are most applicable to forested stands, but have applicability to shrublands as well. Forested stands are commonly observed and described by the following layers: seedling, sapling, pole, suppressed, intermediate, co-dominant, and dominant. These same definitions can be used to mentally subdivide the stand. Not all layers will be present. And on occasion, there may actually be two or more layers within the traditional forestry concepts. The objective is to adequately describe the stand structure, without getting inordinately detailed.

For example, one layer of ponderosa pine might be all individuals over 50 feet tall; another layer would be all individuals between 25 and 50 feet; a third layer would be 5 to 25 feet; and a fourth layer would be all seedlings and saplings less than 5 feet.

Several layers may be described for each species. Record the minimum, average, and maximum height for each observable layer within the recorded species. A layer description is optional for graminoid and forb life forms.

MINIMUM HEIGHT (4-NUM)

Enter the average minimum height of the layer to the nearest tenth of a foot. This value represents the average height of the shortest individuals occupying the layer.

AVERAGE HEIGHT (4-NUM)

Enter the average height of the layer to the nearest tenth of a foot. This value is the average height of all individuals in the layer.

MAXIMUM HEIGHT (4-NUM)

Enter the average maximum height of the layer to the nearest tenth of a foot. This value represents the average height of the tallest individuals occupying the layer.

All Three Are Required.
Accuracy Standards = ± 10 percent of the height.

AVERAGE DIAMETER (3-NUM)

Record the average diameter to the nearest 1 inch class, for the species. If there are three Ponderosa pine trees within one layer with diameters of 12", 16", and 17", the average diameter recorded is 15". If there are two distinct sizes within a layer, the species can be entered twice. Use "00" for established tree seedlings. Diameter is taken at breast height for all trees, except junipers and piñon pine. Diameter is taken at the root collar for all junipers, piñon pines, and shrubs. Diameter is also recorded for standing dead or down dead trees or shrubs.

Required.
Accuracy Standards = ± 10 percent of the diameter.

CANOPY COVER (3-NUM)

Enter the best estimate of canopy cover for each species by layer. This percentage is unique to that particular layer/species combination. Percent cover for a species can total more than 100 percent. For example, two layers of lodgepole pine would be considered independently. Leave percent cover blank for standing dead trees and for down material.

The actual cover observed during field sampling is entered in this field. If a particular species was sampled sufficiently early or late in the year that you believe its cover at peak phenological development would be greater or lower than observed, make a comment in the Notes field.

Required.
Accuracy Standards = ± 10 percent of the mean.

MATURITY (1-CHAR)

Record the appropriate maturity code for the life form. Codes are available for shrub and tree species. The following codes are used to indicate relative maturity or physiological age rather than actual age. This is a substitute for boring trees to determine age. Differences in site, elevation, moisture and other environmental factors influence the age at which trees re[illegible]y. Trees generally reach maturity earlier on poor sites [illegible] sites.

Trees and shrubs are divided into the following maturity classes which were developed for ponderosa pine only. Maturity estimates for other species will have to be estimated by the age of core sampled trees.

TREE MATURITY CLASSES

CODE	DESCRIPTION	CROWNS	BRANCHES	BARK
Y	Young: trees appear young	pointed	distinct whorls, upturned, small in comparison with the main stem	generally smooth and not platey
I	Immature: trees appear middle-aged	may be pointed or slightly rounded, but never flat	slightly flattened lower branches	slightly rough, plates beginning to form
M	Mature: trees slightly showing age	pyramidal or rounded, occasionally pointed	flattened lower branches	rough, somewhat platey
O	Overmature: trees show age	flattened or rounded, but never pointed	open, large, gnarled or misshaped upper branches	platey or deeply furrowed
D	Dead: standing dead	N/A	N/A	N/A

SHRUB MATURITY CLASSES

CODE	DESCRIPTION	CROWNS	BRANCHES	BARK
Y	Young: relatively young plant	not rounded and are made up of all living wood; larger than a sprout or seedling (1/8-inch to 1/2-inch diameter at the base, varying with species)	more complex branching; may possess multiple basal stems but is attached to a relatively small root stock (except for saplings); may or may not show signs of flowering and seed production	more fibrous but is not fissured as with a mature plant
M	Mature: trees slightly showing age	rounded growth form, large, heavy, often gnarled stems and a firmly established predominant root stock; root crown is made up of three-quarters or more living wood	complex branching and multiple stems; evidence of flowering and or seed production is present	fibrous fissured bark
D	Decadent	mature plant which possesses more than 50 percent dead wood in the crown	N/A	N/A
X	Dead: standing dead	obviously does not possess any live crown, but the root is still firmly attached (downed, unattached, woody stems are considered litter)	N/A	N/A

Required.
Accuracy Standards = Good Judgment.

AGE (3-NUM)

Record the age of core sampled trees or shrubs in the layer the tree or shrub falls within. For example, 50 years is the recorded age for a layer with three ponderosa pines of 45, 50, and 55 years old. Age is most often needed for tree species, but may occasionally by taken for shrub species. No add-on factor is applied to the age. Use the core samples to calibrate maturity class estimates, being conservative in the number of trees sampled.

Required.
Accuracy Standards = ± 10 percent of the age.

VIGOR (1-CHAR)

For life forms describe the overall health, vigor, and maturity of crowns within a canopy layer. Record the appropriate vigor code for live trees. These class descriptions can be applied to all tree layers:

CODE	DESCRIPTION	CROWNS	FOLIAGE	POSITION	DBH
F	Full	well filled out vigorous crown	usually very dense and thrifty, the individual leaves being of average length or longer	usually isolated or dominant	large for age
M	Medium	fair to moderately vigorous crown or a longer crown if narrow or somewhat thin; either short wide crowns or long narrow ones, but neither sparse nor ragged	usually thrifty, of full to medium density and of average length	usually co-dominant but often isolated or dominant	above average for age
L	Light	of fair to poor vigor either short or long, sparse and narrow	usually short and from medium to poor density. Of normal length and density when confined to the top third of the tree	usually intermediate or sometimes co-dominant, but rarely isolated	usually below average
W	Weak	usually of very poor vigor, often quite thin and sickly, consisting of a tuft at the top of the tree or dead top	usually short and of poor to very poor density, very sparse and scattered or only partially developed; often barely sufficient to maintain life	usually suppressed or intermediate or if dominant or co-dominant it is suffering from some vigor reducing ailment such as severe insect attack, lightning strike or very old age	usually decidedly subnormal, but very old. Damaged trees are often of large diameter

Required.
Accuracy Standards = Good Judgment.

NUMBER OF DEAD (3-NUM)

Record the number of dead standing trees greater than 5 inches in diameter. On a separate line record the dead down material greater than 5 inches in diameter. Both are based on the sample size used. At least half of the piece must lie within the plot to be counted.

Required.
Accuracy Standards = ± 10 percent.

DECAY (1-CHAR)

For dead standing trees or down material, record the condition of the standing dead tree or down piece using one of the five decay classes depicted below (page 3-53). Detailed descriptions of down material decomposition classes are provided. These descriptions, along with a relative value (last row of table), are useful in determining the snag condition class as well.

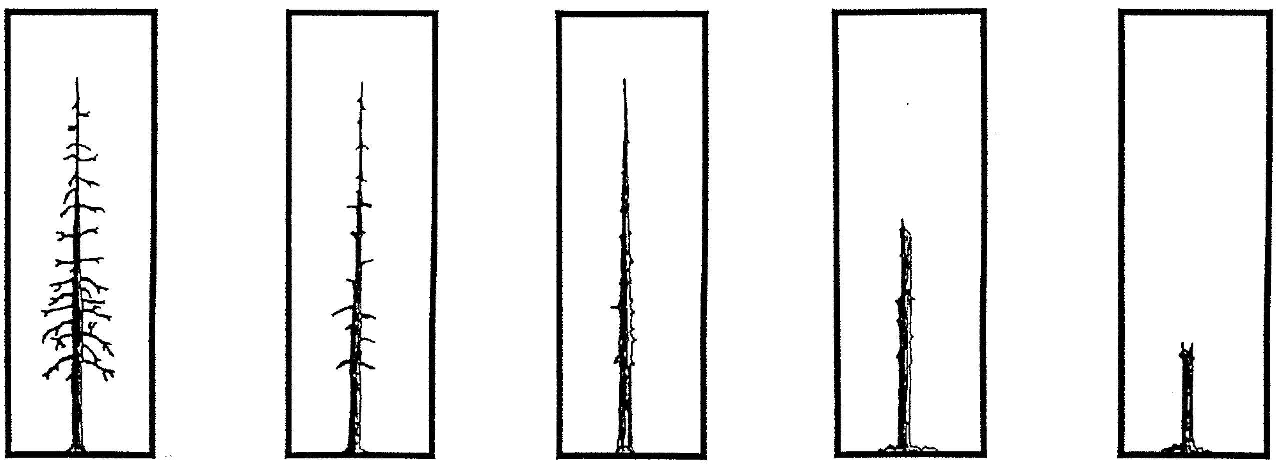
FIVE-CLASS SYSTEM OF LOG DECOMPOSITION[8]

Log Characteristics	Log Decomposition Class				
	1	2	3	4	5
Bark	intact	intact	trace	absent	absent
Twigs <3 cm (1.2 in)	present	absent	absent	absent	absent
Texture	intact	intact to partly soft	hard, large pieces	small, soft, blocky pieces	soft and powdery
Shape	round	round	round	round to oval	oval
Wood Color	original color	original color	original color to faded	light brown to faded brown or yellowish	faded to light yellow or gray
Portion of log on ground	log elevated on support points	log elevated on support points but sagging slightly	log is sagging near ground	all of log on ground	all of log on ground
Snag Condition relative to Log Decomposition Class	hard snag	hard snag	soft snag	soft snag, >70% soft sapwood	disintegrated

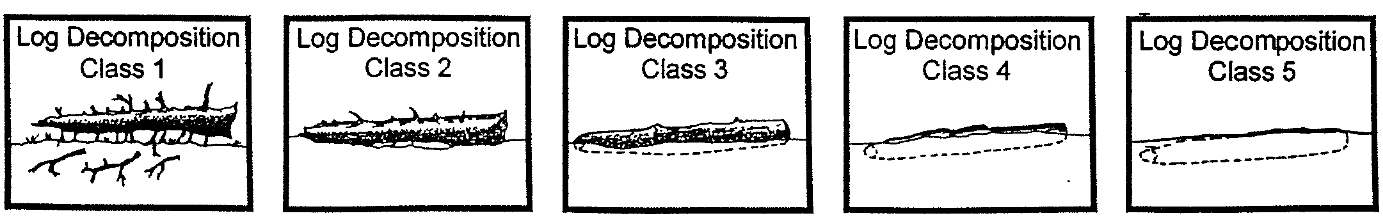
Required.
Accuracy Standards = Good Judgment.

[8]From Thomas, Jack Ward, tech. ed. 1979. Wildlife Habitat in Managed Forests -- the Blue Mountains of Oregon and Washington. USDA Forest Service, Ag Handbook No. 553, 512 pp.

STANDING DEAD AND DOWN MATERIAL DECAY CLASSES



Class 1 Class 2 Class 3 Class 4 Class 5



DOWN LENGTH (3-NUM)

Record the average length for down material. Round to the nearest one foot.

Required.
Accuracy Standards = ± 10 percent of the length.

NOTES

Available for any short comments. During the transition period between using other species coding systems and the SCS PLANTS data base codes, it is advisable to make a note as to the scientific name. This is particularly important for graminoids, forbs, and some shrubs, especially where there is a high probability that the code species symbol can be confused for more than one species.

Optional.
Accuracy Standards = Good Judgment.

NOTE: Any comments concerning your plot should be recorded on the Comments Data Form (R2-2200-CD Form CD if you want an electronic record of your commen...

The following table displays the data elements that are generally completed for each life form.

	Life	Species	Layer Heights			Avg	Canopy	Live			Dead		
	Form		Min	Avg	Max	Diam	Cover	Mat	Age	Vigor	#	Decay	Length
Tree	X	X	X	X	X	X	X	X	X	X	X	X	X
Shrub	X	X	X	X	X		X						
Graminoid	X	X					X						
Forb	X	X					X						

CULAR PLANT COMPOSITION
R2-2200-OP)
lora Identification Source: W86

F1-7: F S -- 0 2 -- 0 4 -- 0 9 -- 9 4 -- M B -- 0 8 2
Plot ID Agency Region Forest District Year Exam'r Plot Number
Plant Identification Level: 00

	LF	Species	Layer Heights			Avg	Canopy	Live (only)			Dead (only)			Notes
			Min.	Avg	Max.	Diam	Cover	Mat	Age	Vigor	#	Decay	Len	
1	T	POTR5	10	18	20	4	10	Y	30	M				*P. tremuloides*
2	T	POTR5	1	4	8	1	5	Y	10	M				
3	T	POTR5	3	8	15	2					8	2		
4	T	SABE2	1	2	2	1	3	Y						*S. bebbiana*
5	S	ARTRV	1	2	2		20							
6	S	SYOR2	0	1	1		2							
7	S	CHNA2	0	1	1		1							
8	S	CHVI8	1	1	3		2							
9	S	RILA	0	1	2		1							
10	S	SARA2	1	1	2		3							
11	G	FETH					2							
12	G	CAEL3					2							
13	G	POPR					10							
14	G	PONE2					50							
15	G	CAGE2					1							
16	G	KOMA					2							
17	G	CAFI					2							
18	G	KOCR					1							
19	G	PASM					5							
20	G	BROMU					5							
21	F	ACLA5					25							
22	F	TAOF					20							
23	F	MEFU2					5							
24	F	LATHY					10							
25	F	VIAM					10							
26	F	DEBA2					5							
27	F	RAGL					4							
28	F	NOMO2					1							*Noccaea montana*
29	F	ANSE4					1							
30														
Req	Z	WOOD					2							
Req	Z	LITTER/DUFF					25							
Req	Z	MOSS/LICHEN					2							
Req	Z	BASAL VEG					1							
Req	Z	WATER					0							
Req	Z	BARE SOIL					10							< 2 mm
Req	Z	GRAVEL					1							2mm - 3 in
Req	Z	COBBLE					1							3 - 10 in
Req	Z	STONE					1							10 - 24 in
Req	Z	BOULDER					0							> 24 in
Req	Z	BEDROCK					0							

F1-7: F S -- 0 2 -- 0 4 -- 0 9 -- 9 4 -- M B -- 0 8 2

Plot ID Agency Region Forest District Year Exam'r Plot Number

	LF	Species	Layer Heights			Avg	Canopy	Live (only)			Dead (only)			Notes
			Min.	Avg.	Max.	Diam	Cover	Mat	Age	Vigor	#	Decay	Len	
31														
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COVER-FREQUENCY TRANSECT METHOD
R2-2200-CF

GENERAL DISCUSSION

In most cases, this is the most commonly used vegetative inventory method for the Rocky Mountain Region. The cover-frequency transect is commonly used to provide quantitative measurements of canopy cover and frequency by plant species, ground cover, and production by life form for inventory and monitoring purposes. It is used when a replicated sampling design and statistical analysis are required. It is also used to calibrate ocular estimates of canopy cover when crews are unfamiliar with the ocular plant composition method. Use this method for low shrubs and herbaceous species.

ADVANTAGES AND LIMITATIONS

This method is relatively fast and easy to learn. It is applicable to a wide variety of plant species. Canopy cover and frequency is widely used in vegetation classifications throughout the western United States. A limitation of this method is with vegetation over 3 feet tall, in which case the examiner may want to use the line intercept method in addition to this method.

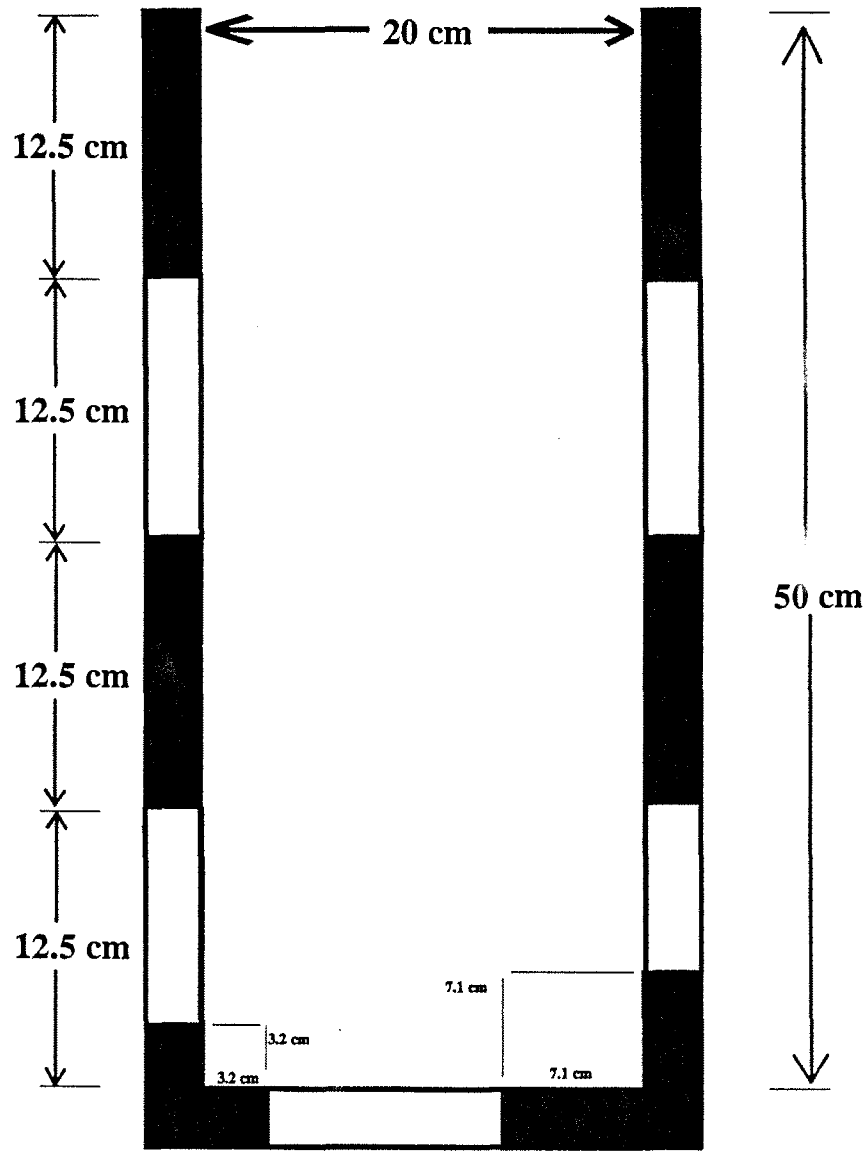
TRAINING

Examiners must be knowledgeable in plant identification. Estimating canopy cover by species using a plot frame and cover classes is relatively easy to learn.

PERSONNEL AND EQUIPMENT

Required equipment for completing a cover-frequency transect includes a 20 x 50 cm plot frame painted to indicate the seven standard cover classes as described by Daubenmire (see Figure 3-9), a 100-foot tape marked in feet and tenths of feet, temporary stakes for transect ends (large screw drivers with orange or yellow handles work well), and permanent stakes if the transect is to be permanently established. Two forms must be completed for the Cover-Frequency Transect Method: General Field Data Form (R2-2200-GF) and Cover-Frequency Data Form (R2-2200-CF).

Figure 3-9. COVER-FREQUENCY FRAME (20 x 50 cm)



The frame is made of 0.5 inch PVC or 0.25 inch metal rod. *Note: Do not use any material larger than 0.5 inch outside diameter. The larger diameter material reduces accuracy.* The inside dimensions of the frame are 20 x 50 cm. The frame is open-ended to facilitate placement under dense or tall vegetation.

The seven cover class frame is divided into fourths by painting alternate sections of the frame different colors as illustrated. Use orange and white or red and white paint schemes.

In one corner of the frame, delineate two sides of an area 7.1 cm square (inside dimension) as illustrated. This area represents 5

percent of the plot area. In the opposite corner, delineate two sides of an area 3.2 cm square (inside dimension) as illustrated. This areas represents 1 percent of the plot area.

The painted design provides visual reference areas equal to 1, 5, 25, 50, 75, 95, and 100 percent of the plot area.

SAMPLING PROCEDURE

Canopy cover is two-dimensional evaluation of the influence each plant species exerts over other components of the ecosystem, that is, the dominance of the species.

TRANSECT LAYOUT

1. Recon the entire site, making mental notes. Choose homogeneous portions of the site for transect locations, away from ecotones and unusual (very minor acreage) micro-sites. Choose transect orientation that will correctly reflect relative acreage of micro-sites/patches that are uniformly distributed (pattern) throughout the site. Transect location and orientation is designed to accurately describe the site (not the type, nor the micro-site) for both vegetation and soil.

2. Put in a pin at transect start (screwdriver, re-bar, or pipe), draw tape tight, and put in pin at other end to hold tape while reading.

3. Place range pole or upright plot frame for scale, and identification sheet (R2-2200-PH) at transect start. Take photos before reading the transect (page 3-39).

3. Twenty plot frames will be placed on right side of tape at 5 foot intervals beginning at the 0 foot point on the tape. The lower left corner of the plot frame will be placed adjacent to the appropriate foot mark on the tape. Refer to plot frame placement diagram (Figure 3-10).

4. At each plot frame, estimate ground cover and live foliar canopy cover by species and record using seven standard cover classes (Table 3-7). Also estimate ground cover categories: bare soil and other mineral particle sizes, litter and wood, moss and lichen, basal vegetation, and water. Canopy cover values will not necessarily sum to 100 percent, while ground cover estimates will sum to 100 percent. Cover estimates made with cover class midpoints may not sum to 100, but should be between 90 and 110 percent.

Table 3-7. CANOPY COVER CLASSES (DAUBENMIRE).

CODE	RANGE	MIDPOINT
T	0 - 1.0% cover	0.5%
1	1.1 - 5.0% cover	2.0%
2	5.1 - 25.0% cover	15.0%
3	25.1 - 50.0% cover	37.5%
4	50.1 - 75.0% cover	62.5%
5	75.1 - 95.0% cover	85.0%
6	95.1 - 100.0% cover	97.5%

METHOD OF RECORDING DATA

Consider all (live) individuals of one species in the plot frame as a unit, ignoring for the moment all other kinds of plants. Also ignore dead individuals or dead branches of live individuals; record dead individuals and branches on a separate line if needed.

Imagine a line drawn about the leaf tips of the undisturbed canopies (ignoring inflorescences) and project those polygonal images onto the ground. This projection is considered "canopy cover" for the species being considered.

Decide which of the classes (Table 3-7) the canopy coverage of the species falls into, and record this value. Then consider the remaining species in turn (Figure 3-11).

Note that a plant does not have to be rooted in the plot frame to have coverage over it. Small openings within the canopy are included in the measurement. This is not an estimate of leaf area.

Figure 3-10. COVER-FREQUENCY TRANSECT LAYOUT

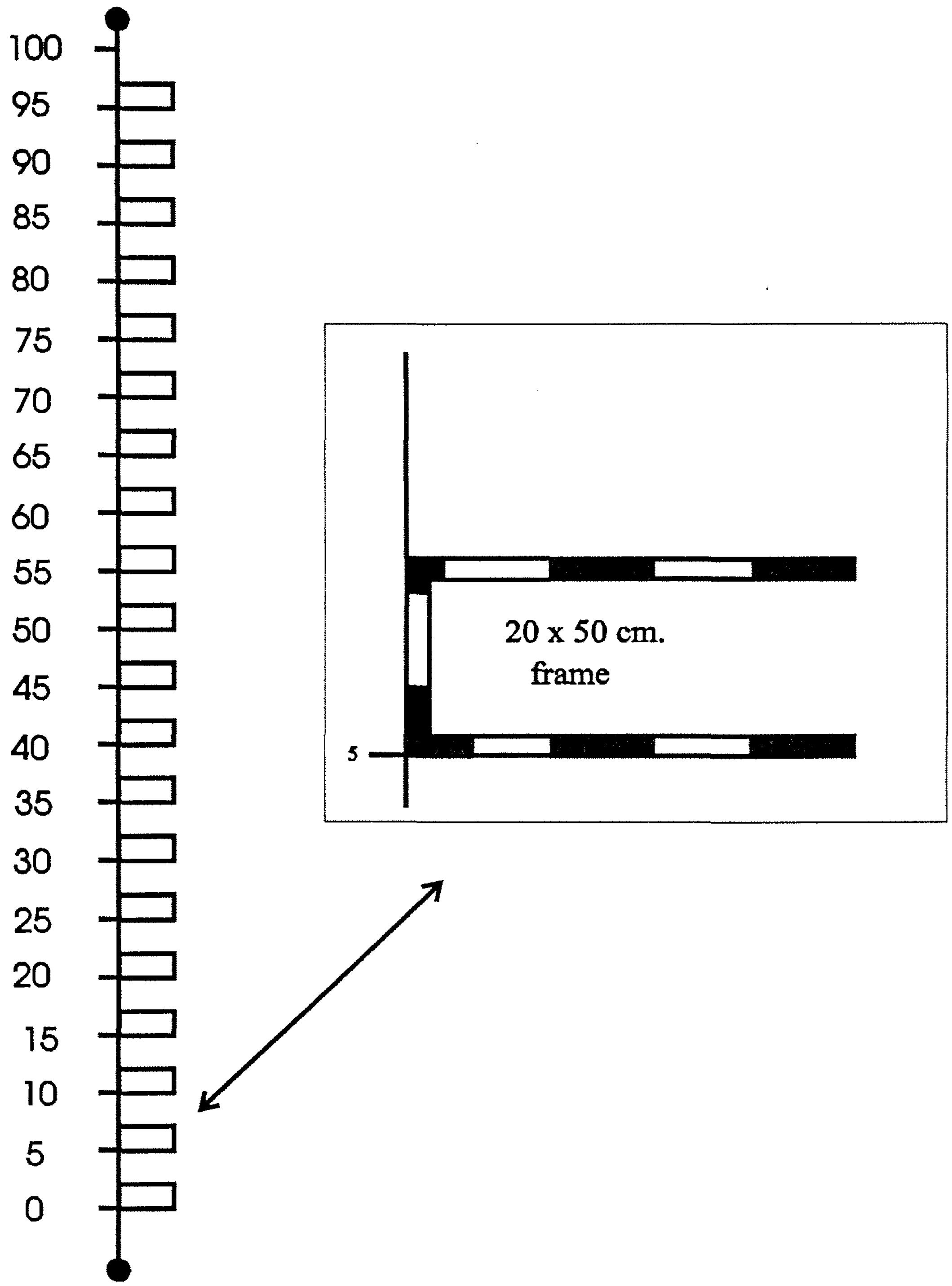
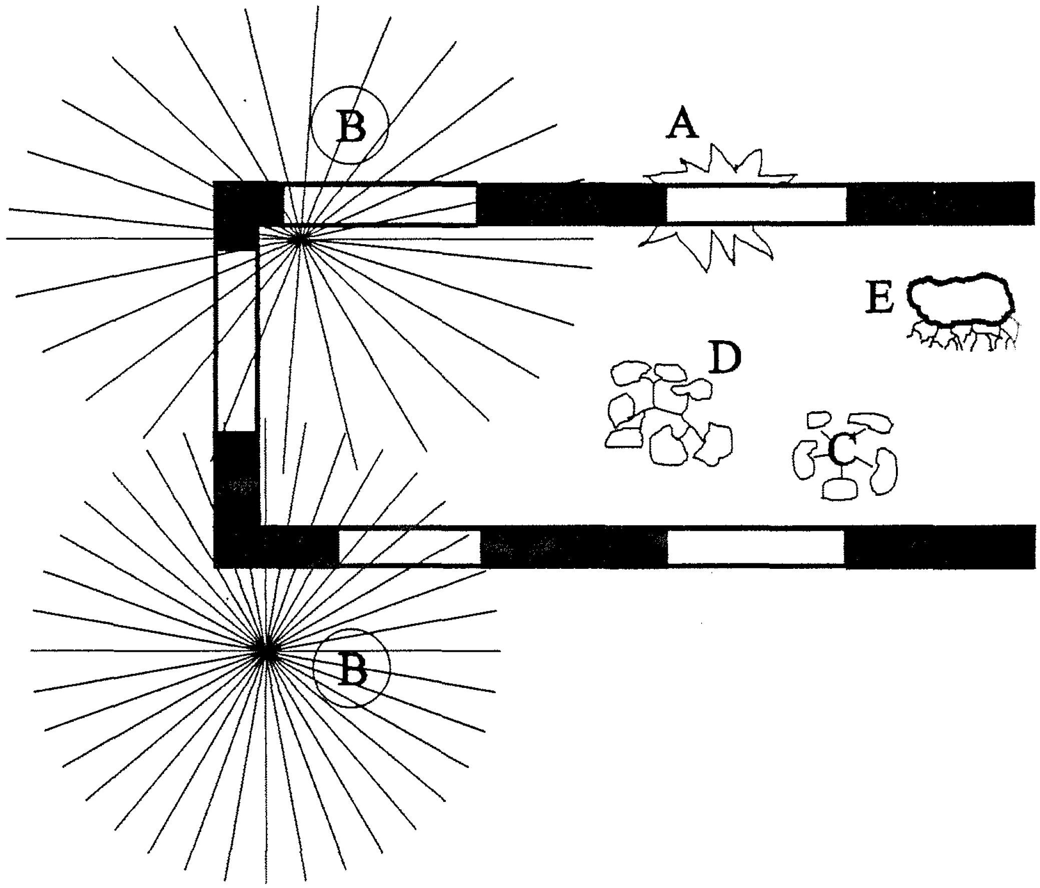


Figure 3-11. LIVE FOLIAR COVER DIAGRAM



Examples of estimating canopy cover classes:

Species A	Cover class "T" (0-1% cover) (Estimate cover inside the frame even though base of plant may be outside frame.)
Species B	Cover class "3" (25-50% cover)
Species C	Cover class "1" (1-5% cover)
Species D	Cover class "2" (5-25% cover)
Species E	Cover class "1" (1-5% cover) (Note: Do not count dead cover.)

FORM DESCRIPTION R2-2200-CF and R2-2200-CFSum

The Cover-Frequency Data Form (R2-2200-CF) accommodates up to 45 items and 20 plot frames per transect. If there are more than 45 species on the transect, use additional field sheets as appropriate (that is, the data base can accommodate as many species as are present on up to 10 transects).

A summary data form (R2-2200-CFSum) is provided which is used in data entry (that is, information by species is entered by transect summary not by individual plot frame).

FIELDS 1-7: RECORD IDENTIFIER (15-CHAR)

Enter the Key ID identified in Fields 1-7 of the General Field Data Form (R2-2200-GF).

Required.
Accuracy Standards = No Errors.

FIELD 8: PLANT IDENTIFICATION LEVEL (2-CHAR)

Identify the sampling type conducted in the first column (Code 1). Identify whether all plants or only selected plant species, genera, or life forms encountered in-plot frames are measured (Code 2).

CODE 1	SAMPLING TYPE
C	Only cover/frequency data are being collected
N	Only rooted nested frequency data are being collected
B	Both types of data are being collected

CODE 2	SPECIES IDENTIFICATION LEVEL
A	All plants encountered are being measured to species, genera, or life form
S	Selected species, genera, or life forms are being measured

NOTE: This field cannot be left blank during data entry.

Required.
Accuracy Standards = No Errors.

FIELD 9: NUMBER OF TRANSECTS (2-NUM)

Identify which transect this form is for by idenitfying transect number "x" of "y" where "x" is the transect number and "y" is the total number of transects in the sample, usually one and sometimes as many as two or three. This number cannot exceed ten.

Required.
Accuracy Standards = No Errors.

FIELD 10: TRANSECT LENGTH (3-NUM)

Enter the total length of the transect. The standard length for the Rocky Mountain Region is 100 feet.

Required.
Accuracy Standards = No Errors.

FIELD 11: NUMBER OF FRAMES PER TRANSECT (2-NUM)

Enter the number of plot frames used to record cover and/or frequency along a transect. The standard, and minimum, number of plot frames for the Rocky Mountain Region is 20. More than 20 may be used if the variability of the site or other reasons warrant. Do not use less than 20 plot frames per transect.

Required.
Accuracy Standards = No Errors.

FIELD 12: FRAME RADIUS OR LENGTH (3-NUM)

Enter the radius or length of the plot frame used in cover-frequency sampling to the nearest cm. For example, a rectangular plot frame 50 cm long would be entered as "50.0".

Required.
Accuracy Standards = No Errors.

FIELD 13: FRAME WIDTH (3-NUM)

Enter the width of the plot frame used in cover-frequency sampling to the nearest cm if a rectangular plot frame shape is used. Enter "0.0" if a circular plot frame is used.

Required.
Accuracy Standards = No Errors.

FIELD 14: LIFE FORM (1-CHAR)

Enter one of the following codes to describe the correct life form for each plant species, genus, or life form being sampled.

CODE	LIFE FORM
T	tree (includes conifer and broadleaf trees)
S	shrub (includes woody stemmed vines and subshrubs)
G	graminoid
F	forb
E	fern/allies (includes *Lycopodium* and *Selaginella*)
M	moss
L	lichen
U	fungus
A	alga
Z	not applicable

Required, for plant species.
Accuracy Standards = No Errors.

> *NOTE: Whenever a plant species code (or symbol) is required, use the 8-character alpha-numeric codes from the standard Soil Conservation Service's PLANTS data base. Lists of all species by state are available from the Forest botanist, ecologist, or soil scientist.*

FIELD 15: ITEM NAME (8-CHAR)

The Cover-Frequency data base can accommodate all items sampled on as many as 10 transects, even though the field form only allows 45 entries per page. Use as many pages of Form R2-2200-CF as needed to record all items of interest in sampling.

During the transition period between using other species coding systems and the SCS PLANTS data base codes, it is advisable to make a note as to the scientific name. This is particularly important for graminoids, forbs, and some shrubs, especially where there is a high probability that the code species symbol can be confused for more than one species.

Required.
Accuracy Standards = No error in species level identification for dominant, common, or habitat type indicator plants.

CANOPY COVER DATA (2-NUM)

For each plant species or selected species in the plot frame, estimate the canopy cover within the plot frame and record the appropriate code to denote that value. *NOTE: Individual plot frame cover data for plant species are not entered in the data base. They are totaled and averaged by transect and entered in Field 16.*

CODE	RANGE	MIDPOINT
T	0 - 1.0% cover	0.5%
1	1.1 - 5.0% cover	2.0%
2	5.1 - 25.0% cover	15.0%
3	25.1 - 50.0% cover	37.5%
4	50.1 - 75.0% cover	62.5%
5	75.1 - 95.0% cover	85.0%
6	95.1 - 100.0% cover	97.5%

Required.
Accuracy Standards* = ± *1 class.

SUM CANOPY COVER FOR TRANSECT (SCC)

Total the midpoints for canopy cover for all plot frames in the transect and record in this space.

Required.
Accuracy Standards = No Errors.

FIELD 16: AVERAGE CANOPY COVER (ACC) (3-NUM)

For each plant species sampled, divide the summed foliar canopy cover within the transect (SCC) by the number of plot frames sampled on each transect (M/T). *Round the resulting quotient to the nearest percent (whole number) for values greater than or equal to 1.0 percent. Round to the nearest tenth of one percent if the average canopy cover is less than 1.0 percent.* Enter the average canopy cover for the transect in the column labeled "ACC".

For example, *Poa tracyi* (POTR) is found in 4 of 20 plot frames on the transect. The cover classes recorded are: 1, 3, 2, and 5. Sum the mid-points of each class, then divide by 20 to get the average canopy cover of POTR for the total area sampled ransect).

$$2.0\% + 37.5\% + 15\% + 85\% = 139.5$$
$$139.5 / 20 = 7\%$$

Required.
Accuracy Standards* = ± *10 percent.

FIELD 17: PERCENT FREQUENCY (3-NUM)

Divide the number of plot frames in which a given item is present by the total number of plot frames on the transect (field 11). Convert that value to a percent by multiplying by 100. Continuing with the above example, the frequency of *Poa tracyi* is:

$$4 / 20 \times 100\% = 20\%$$

Required.
Accuracy Standards = No Errors.

FIELD 18: COVER-FREQUENCY INDEX (5-NUM)

Multiply the average canopy cover (field 16) by the percent frequency (field 17). This value is the cover-frequency index (CFI) and is used in similarity coefficient computations.

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COVER-FREQUENCY DATA
(R2-2200-CF)

F1-7: F S -- 0 2 -- 0 4 -- 0 9 -- 9 4 -- M B -- 0 8 2

Plot ID Agency Region Forest District Year Exam'r Plot Number

F8 Plant ID C A F9 Tran: 1 of 3 F10 Tran Len: 1 0 0 F11 Fr/Tran 2 0 F12 Fr Rad/Len 5 0 . 0 F13 Fr Wid 2 0 . 0

ACC x % Freq = CFI

	F14	F15	Canopy Cover Data																					F16	F17	F18
	LF	Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	SCC	ACC	% Freq	CFI
1	T	POTR5																								
2	T	SABE2																								
3	S	ARTRV							2	5		3	3		3		2	2		4	2	2	335	17	50	850
4	S	SYOR2																								
5	S	CHNA2												T						2			15.5	0.8	10	8
6	S	CHVI8					1	3						T									40	2	15	30
7	S	RILA																								
8	S	SARA2																								
9	G	FETH		3																			37.5	2	5	10
10	G	CAEL3													2	2							30	2	10	20
11	G	POPR	2	2		2	2	2	3			2	3				2			2			195	10	50	500
12	G	PONE2	4	5	5	6	4	2	3	5	5	4	2	4				3	4	2			870	44	75	3300
13	G	CAGE2																								
14	G	KOMA	2	2																			30	2	10	20
15	G	CAFI																								
Req	Z	WOOD		T										T		1	2						18	0.9	20	18
Req	Z	LITTER/DUFF	4	3	4	3	5	2	2	4	3	4	3	5	4	3	2	4	3	5	4	3	1000	50	100	5000
Req	Z	MOSS/LICHEN	T	T		T	T	2				2			T	3	2	T	1		T	1	90	5	65	325
Req	Z	BASAL VEG	T	1	T	2	T	T	1	T	T	T	T	1	1	T	T	T	T	1	1	T	33.5	2	100	200
Req	Z	WATER																								
Req	Z	BARE SOIL <2mm	2	3	3	3	2	4	5	3	4	2	3	1	3	2	2	3	4	1	3	1	653.5	33	100	3300
Req	Z	GRAVEL 2mm-3in	2	1	T			1					2	T		1					T	3	75	4	45	180
Req	Z	COBBLE 3-10in		2						T			1		1							1	21.5	1	25	25
Req	Z	STONE 10-24in												T			3						38	2	10	20
Req	Z	BOULDER >24in	1									T											2.5	0.1	10	1
Req	Z	BEDROCK																								

T	0 - 1.0% cover	0.5%	2	5.1 - 25.0% cover	15.0%	4	50.1 - 75.0% cover	62.5%	6	95.1 - 100.0% cover	97.5%
1	1.1 - 5.0% cover	2.0%	3	25.1 - 50.0% cover	37.5%	5	75.1 - 95.0% cover	85.0%			

COVER-FREQUENCY DATA
(R2-2200-CF)

F1-7: F S -- 0 2 -- 0 4 -- 0 9 -- 9 4 -- M B -- 0 8

Plot ID	Agency	Region	Forest	District	Year	Exam'r	Plot Num
	F S	0 2	0 4	0 9	9 4	M B	0 8

ACC x % Freq = CF

	F14	F15	Canopy Cover Data																					F16	F17	F18
	LF	Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	SCC	ACC	% Freq	CFI
16	G	KOCR																2					15	0.8	5	4
17	G	PASM													2		3			3			90	5	15	75
18	G	BROMU														2					2	3	67.5	3	15	45
19	F	ACLA5		4	2	2	3	3	2	2	2		3			4	2	2	4	2	2		497.5	25	80	2000
20	F	TAOF			2		2	3	2	T		2	2	2	3	3	2	4	2	2	5	2	410.5	21	80	1680
21	F	MEFU2	2	2	2			2		T			2	2	2	2							120.5	6	45	270
22	F	LATHY		2		2	2	2	2	4			2	2					2	3			220	11	50	550
23	F	VIAM															2	2	3	3	T	5	190.5	10	30	300
24	F	DEBA2			2			2			2	2	2	2		2		T	T	T		2	121.5	6	55	330
25	F	RAGL										2		2		2							45	2	15	30
26	F	NOMO2												2									15	0.8	5	4
27	F	ANSE4													2								15	0.8	5	4
28																										
29																										
30																										
31																										
32																										
33																										
34																										
35																										
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41																										
42																										
43																										
44																										
45																										

COVER-FREQUENCY SUMMARY
(R2-2200-CFSum)

F1-7: F S -- 0 2 -- 0 4 -- 0 9 -- 9 4 -- M B -- 0 8 2

Plot ID Agency Region Forest District Year Exam'r Plot Number

F8 Plant ID C A F9 Tran: 3 F10 Tran Len: 1 0 0 F11 Fr/Tran 2 0 F12 Fr Rad/Len 5 0 . 0 F13 Fr Wid 2 0 . 0

ACC x % Freq = CFI

	F14	F15	Transect 1			Transect 2			Transect 3			Transect 4			Transect 5			Transect 6			Transect 7			Transect 8			Transect 9			Transect 10		
	LF	Item	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI
1	T	POTR5																														
2	T	SABE2																														
3	S	ARTRV	17	50	850				2	15	30																					
4	S	SYOR2				0.2	5	1																								
5	S	CHNA2	0.8	10	8	25	30	750	10	30	300																					
6	S	CHVI8	2	15	30																											
7	S	RILA																														
8	S	SARA2																														
9	G	FETH	2	5	10	10	50	500																								
10	G	CAEL3	2	10	20																											
11	G	POPR	10	50	500	20	50	1000	6	10	60																					
12	G	PONE2	44	75	3300	35	20	700	10	50	500																					
13	G	CAGE2																														
14	G	KOMA	2	10	20				0.2	5	1																					
15	G	CAFI				0.8	5	4																								
Req	Z	WOOD	0.9	20	1.8																											
Req	Z	LITTER/DUFF	50	100	5000	33	100	3300	68	100	6800																					
Req	Z	MOSS/LICHEN	5	65	325	4	45	180	2	10	20																					
Req	Z	BASAL VEG	2	100	200	1	100	100	1	100	100																					
Req	Z	WATER																														
Req	Z	BARE SOIL	33	100	3300	50	100	5000	25	30	750																					
Req	Z	GRAVEL	4	45	180	0.1	10	1	5	65	325																					
Req	Z	COBBLE	1	25	25	2	10	20	2	10	20																					
Req	Z	STONE	2	10	20																											
Req	Z	BOULDER	0.1	10	1																											
Req	Z	BEDROCK																														

COVER-FREQUENCY SUMMA
(R2-2200-CFSum)

F1-7: FS -- 02 -- 04 -- 09 -- 94 -- MB -- 0

Plot ID Agency Region Forest District Year Exam'r Plot Num

	F14	F15	Transect 1			Transect 2			Transect 3			Transect 4			Transect 5			Transect 6			Transect 7			Transect 8			Transect 9			Transect 10		
	LF	Item	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI	ACC	%F	CFI
16	G	KOCR	0.8	5	4				2	10	20																					
17	G	PASM	5	15	75																											
18	G	BROMU	3	15	45	20	15	300																								
19	G	ELEL5				0.8	5	4																								
20	F	ACLA5	25	80	2000	10	20	200	35	30	1050																					
21	F	TAOF	21	80	1680	10	30	300	25	80	2000																					
22	F	MEFU2	6	45	270				6	45	270																					
23	F	LATHY	11	50	550	10	10	100	16	20	320																					
24	F	VIAM	10	30	300	2	15	30																								
25	F	DEBA2	6	55	330																											
26	F	RAGL	2	15	30				0.8	5	4																					
27	F	NOMO2	0.8	5	4				2	15	30																					
28	F	ANSE4	0.8	5	4	5	5	25																								
29	F	GASE6							2	15	30																					
30	F	ERIOG																														
31	F	PHMU3				0.8	5	4																								
32	F	ANAM							0.8	5	4																					
33																																
34																																
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LINE INTERCEPT METHOD
R2-2200-LI

GENERAL DISCUSSION

This sampling method is primarily used to record tree or shrub species foliar canopy cover. Line intercept is normally used in conjunction with cover-frequency transects when vegetation over 2-3 feet tall exists. It is commonly used to provide quantitative, replicated measurements of plant species cover for monitoring purposes. It is also used to calibrate ocular estimates of shrub cover when crews are unfamiliar with the Ocular Plant Composition Method. These measurements should not be confused with nor compared with plant composition determinations based on rooted nested frequency, density, or weight estimates.

ADVANTAGES AND LIMITATIONS

It provides more precise determinations of canopy cover than ocular assessments. This method is especially useful for quantification of shrub or tree cover greater than 3 feet tall, given that ocular estimation of cover for such species is difficult.

Line intercept is fast, accurate, and relatively free of bias. However, unless specific standards are employed, it may be difficult to obtain consistent results, especially where plants have open crowns. This problem can be avoided by ignoring any holes or openings in the crown and measuring along the perimeter of the live canopy which bisects the transect line. This technique may be difficult to use in dense stands with several species where the canopy of one species overlaps another.

TRAINING

Examiners must be knowledgeable in plant identification.

PERSONNEL AND EQUIPMENT

Equipment required for this method include a 100' tape (marked in feet and tenths of feet), temporary stakes to hold the tape, camera, robel pole for photograph scale, and permanent stakes if the plot is to be established permanently. ***Two forms must be completed for the Line Intercept Method: General Field Data Form (R2-2200-GF) and Line Intercept Data Form (R2-2200-LI).***

SAMPLING PROCEDURE

Line intercept basically consists of an established line transect, usually of 100 feet, where measurements are made of the canopy cover of various plants which are bisected by the line. These intercept measurements are recorded by species to the nearest 1/10 of a foot on Form R2-2200-LI. These measurements provide an estimate of the relative cover for each of the plant species present on the study site.

NUMBER OF TRANSECTS

If the line intercept procedure is used in conjunction with cover-frequency transects, the number and placement of the transect lines should coincide with those established for the cover-frequency study. If using the line intercept method by itself, the number of transects needed to get a reliable sample of a site should be no less then three but may be as many as ten or more.

ESTABLISHMENT OF LINE TRANSECTS

A 100-foot tape is stretched and anchored at the ends. The tape should be as close to the ground as possible while keeping it straight and enabling the investigator to measure the intercept of all the plants.

MEASURING AND RECORDING SHRUB INTERCEPT

Once the desired photos are taken, the next step is to measure where the tape int[illegible] the live canopy. Where necessary, a plumb bob can be [illegible] making these intercept measurements. Measurements will be made and recorded to the nearest one-tenth of a foot.

The procedure for measuring the live crown intercept bisected by the transect line is illustrated in Figures 3-12, 3-13, and 3-14. Use Form R2-2200-LI. Where shrubs are monitored individually on permanent transects, the actual intercept (the position of the shrub along the 100-foot tape, i.e., 3.5 feet - 5.1 feet) must be recorded. In addition to the line intercept measurement of each transect line, the form and age class should also be recorded per the descriptions, of form and age class listed in the Inventory Chapter (page 3-89).

SUMMARIZING DATA

After all line intercept measurements are taken, the actual intercept should be totaled by species at the bottom of the form. Compile the results from each line, calculating percentages for cover and composition.

Figure 3-12.

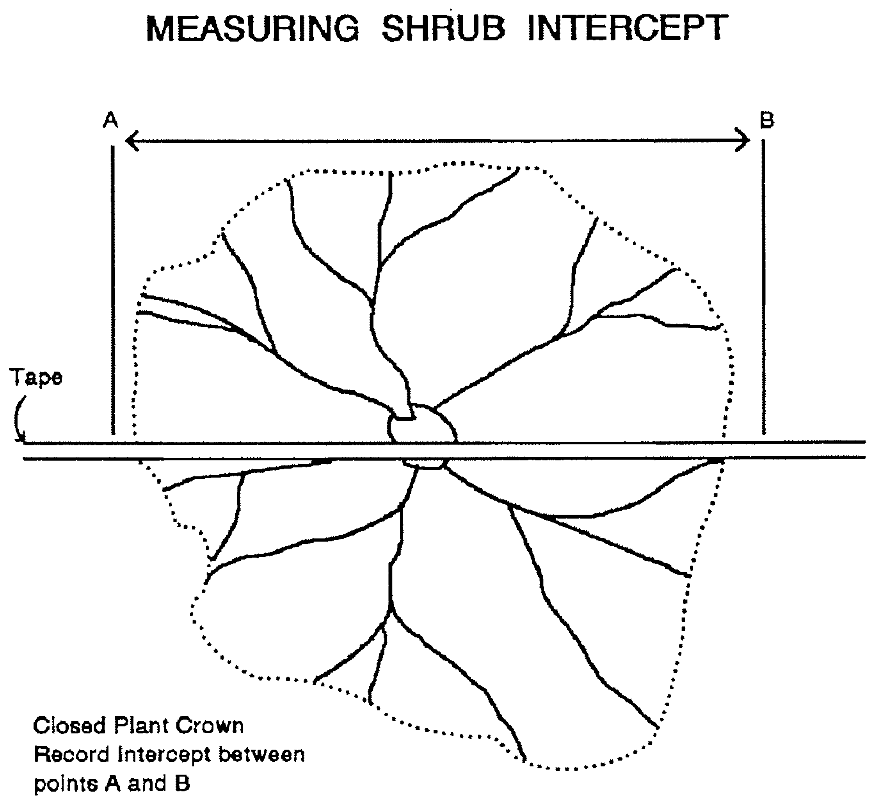


Figure 3-13. MEASURING SHRUB INTERCEPT

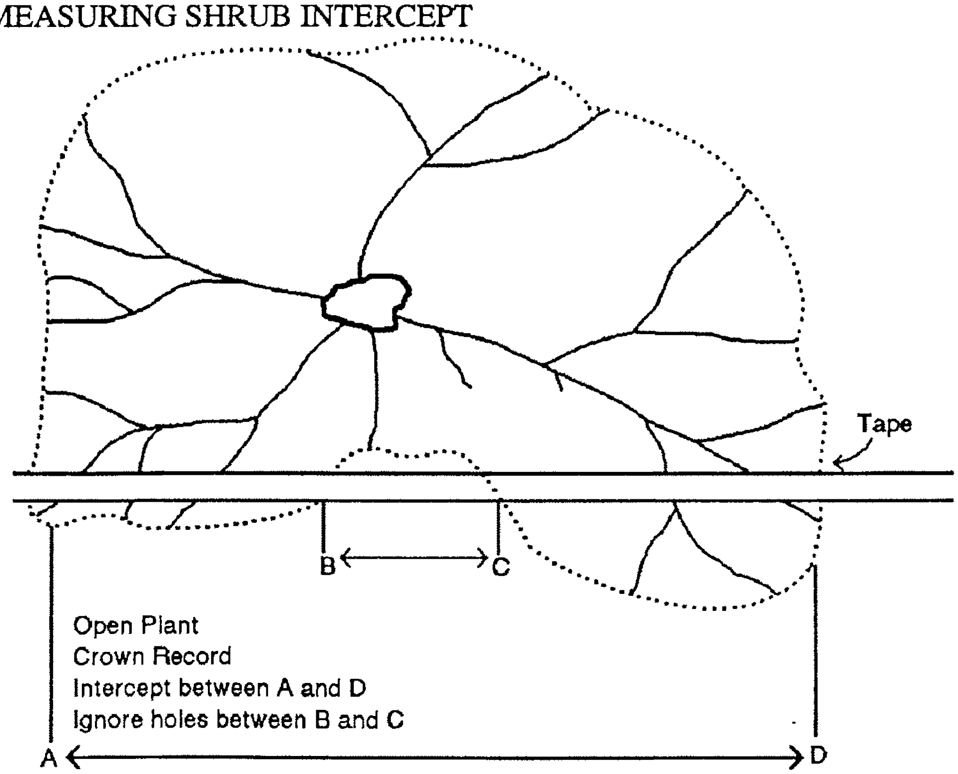
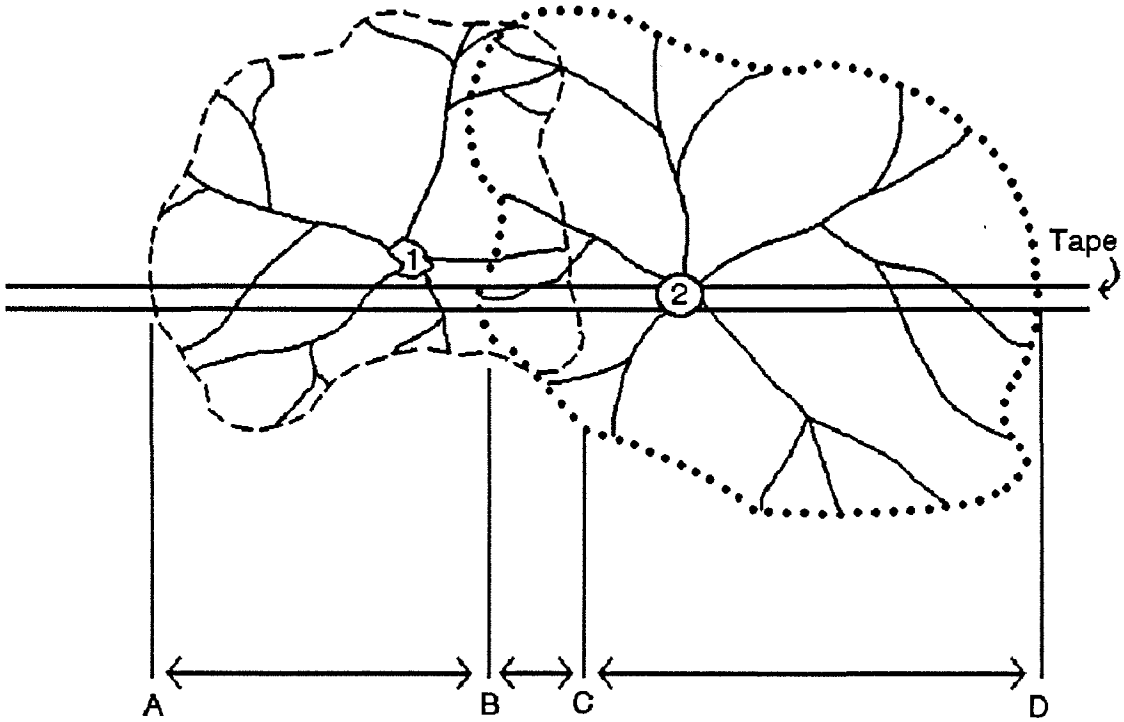


Figure 3-14.

MEASURING SHRUB INTERCEPT



Overlapping Growth:

If plants are of the same species, record intercept between A and D. If they are different species, record the intercept of the first species between points A-C and between B-D for the second species.

FORM DESCRIPTION R2-2200-LI

There is room for 10 species on field form R2-2200-LI; however, there is no limit to the number of items that can be sampled and entered into the data base. Consequently, use as many pages of this form as needed to sample all the items of interest in the study.

The information from the R2-2200-LI Form is summarized on the R2-2200-LISum Form. The latter form is used for data entry into the data base. Rather than entering every start and stop value for every species, just the total length of intercept is entered for each species on each line intercept transect.

FIELDS 1-7: RECORD IDENTIFIER (15-CHAR)

Enter the Key ID identified in fields 1-7 of the General Field Data Form (R2-2200-GF).

Required.
Accuracy Standards = No Errors.

FIELD 8: NUMBER OF TRANSECTS (2-NUM)

Identify which transect this form is for by idenitfying transect number "x" of "y" where "x" is the transect number and "y" is the total number of transects in the sample, usually one and sometimes as many as two or three. This number cannot exceed ten.

Required.
Accuracy Standards = No Errors.

FIELD 9: TRANSECT LENGTH (3-NUM)

Enter the total length of the transect. The standard length for the Rocky Mountain Region is 100 feet.

Required.
Accuracy Standards = No Errors.

SPECIES 1-10 (8-CHAR)

Enter the species code of the plants encountered on the line intercept. Use more than one form if necessary. The total length of intercept from the bottom of the page is entered in to fields 13-22 of the R2-2200-LISum Form. Be sure to indicate the age or size class of the species (see page 3-83).

Required.
Accuracy Standards = No Errors.

TOTAL 1-10 (3-NUM)

Sum the total length of intercept encountered for each species. Transfer these values to the R2-2200-LISum Form for data entry.

LINE INTERCEPT COVER (R2-2200-LI)

F1-7: **F S -- 0 2 -- 0 4 -- 0 9 -- 9 4 -- M B -- 0 8 2**

Plot ID	Agency	Region	Forest	District	Year	Exam'r	Plot Number
F1-7:	FS	02	04	09	94	MB	082

F8: Transect: __1 of __2

F9: 1 0 0 Transect Length

Spp 1: ARTRV			Spp 2: SYRO			Spp 3: ROWO			Spp 4:			Spp 5:		
Start	Stop	Intrcpt	Start	Stop	Intrcpt	Start	Stop	Intrcpt	Start	Stop	Intrcpt	Start	Stop	Intrcpt
2.1	3.1	1.0	3.9	4.7	0.8	15.2	17.3	2.1						
6.8	9.1	2.3	15.1	18.1	3.0									
23.0	26.4	3.4	35.2	36.4	1.2									
42.5	44.5	2.0	61.1	64.0	2.9									
59.8	63.2	3.4												
80.1	84.0	3.9												
98.0	100.0	2.0												
	Total=	18.0		Total=	7.9		Total=	2.1		Total=			Total=	

LINE INTERCEPT COVER
(R2-2200-LI)

F1-7: **F S -- 0 2 -- 0 4 -- 0 9 -- 9 4 -- M B -- 0 8 2**

Plot ID Agency Region Forest District Year Exam'r Plot Number

F8: Transect: __ __ of __ __

F9: __ __ __ Transect Length

Spp 6:			Spp 7:			Spp 8:			Spp 9:			Spp 10:		
Start	Stop	Intrcpt	Start	Stop	Intrcpt	Start	Stop	Intrcpt	Start	Stop	Intrcpt	Start	Stop	Intrcpt
	Total=			Total=			Total=			Total=			Total=	

FORM DESCRIPTION R2-2200-LISUM

There is room for 20 species on summary form R2-2200-LISum; however, there is no limit to the number of items that can be sampled and entered into the data base. Consequently, use as many copies of this form as needed to report all the items of interest in the study. The information from the R2-2200-LI Form is summarized on this form. It is this form that is used for data entry into the data base.

FIELDS 1-7: RECORD IDENTIFIER (15-CHAR)

Enter the Key ID identified in fields 1-7 of the General Field Data Form (R2-2200-GF).

Required.
Accuracy Standards = No Errors.

FIELD 8: NUMBER OF TRANSECTS (2-NUM)

Identify the total number of line intercept transects taken on this sample. The total number of transects in the sample is usually one and sometimes as many as two or three. This number cannot exceed ten.

Required.
Accuracy Standards = No Errors.

FIELD 9: TRANSECT LENGTH (3-NUM)

Enter the total length of the transect. The standard length for the Rocky Mountain Region is 100 feet.

Required.
Accuracy Standards = No Errors.

FIELD 10: LIFE FORM (1-CHAR)

Enter one of the following codes to describe the correct life form for each plant species.

CODE	LIFE FORM
T	tree (includes conifer and broadleaf trees)
S	shrub (includes woody stemmed vines and subshrubs)
G	graminoid
F	forb
E	fern/allies (includes *Lycopodium* and *Selaginella*)
M	moss
L	lichen
U	fungus
A	alga
Z	not applicable

Required.
Accuracy Standards = No Errors.

> *NOTE: Whenever a plant species code (or symbol) is required, use the 8-character alpha-numeric codes from the standard Soil Conservation Service's PLANTS data base. Lists of all species by state are available from the Forest botanist, ecologist, or soil scientist.*

FIELD 11: PLANT NAME (8-CHAR)

The Line Intercept data base can accommodate all items sampled on as many as 10 transects, even though the field form only allows 10 entries per page. Use as many pages of Form R2-2200-LI as needed to record all items of interest in sampling.

During the transition period between using other species coding systems and the SCS PLANTS data base codes, it is advisable to make a note as to the scientific name. This is particularly important for graminoids, forbs, and some shrubs, especially where there is a high probability that the code species symbol can be confused for more than one species.

Required.
Accuracy Standards = No error in species level identification for dominant, common, or habitat type indicator plants.

FIELD 12: AGE OR SIZE CLASS CODES (2-CHAR)

Enter one of the following codes to denote the age or size class of an item in line intercept sampling.

LIFE FORM	CODE	COLUMN DESCRIPTION
Coniferous Tree Species	SE	Seedling trees (< 1.0 in DBH or < 4.5 ft tall)
	SA	Sapling trees (1.0 - 4.9 in DBH)
	PT	Pole trees (5.0 - 8.9 in DBH)
	ME	Medium tree (9.0 - 15.9 in DBH) dominated
	LA	Large tree (16.0 - 32.9 in DBH) dominated
	VL	Very large tree (> 33.0 in DBH) dominated
Broadleaf Tree Species	LL	Lower layer seedlings, sprouts, and saplings (< 2.5 ft tall)
	ML	Middle layer sprouts & saplings (2.5 - 6.5 ft tall)
	SP	Sapling and pole trees (≥ 6.5 ft tall and ≤ 8.9 in DBH)
	ME	Medium tree (9.0 - 15.9 in DBH) dominated
	LA	Large tree (16.0 - 32.9 in DBH) dominated
	VL	Very large tree (> 33.0 in DBH) dominated
Shrub Species Size Class	LS	Lower layer (≥ 1 yr old and < 2.5 ft tall)
	MS	Middle layer (2.5 - 6.5 ft tall)
	TS	Upper layer (≥ 6.5 ft tall)
Herbaceous or Shrub Species Age Class	SE	Seedlings (< 1 yr old)
	RS	Regrowth and sprouts (< 1 yr old)
	YO	Young (≥ 1 yr old without accumulate litter and < 10% dead material)
	MA	Mature (accumulated litter present and dead material present is 10-30%)
	DE	Decadent (≥ 30% dead material)

This field allows the examiner to distinguish between age or size classes for the same item by providing a separate line of data for different age or size classes. Item names may be repeated, therefore, only if the accompanying age/size classes differ. Other classes may be substituted for age or size class, such as categories for structure and hardness of snags or downed logs. Such classes must be specific to a given study and should be recorded in the appropriate project file as well as noted on the Comments Form (R2-2200-CD).

Optional.
Accuracy Standards = No Errors.

FIELDS 13-22: COVER DATA BY TRANSECT (10 3-NUM)

Enter the sum of live foliar canopy cover, in tenths of feet, intercepted by the transect by plant species (item) for up to 10 transects. Do not differentiate between individual plants above and below the transect tape. Large gaps (that is, greater than 2 inches) within the live foliar canopy of a species are not included in cover assessments. Total feet of intercept are recorded by plant species and line transect data for data processing. The total recorded cannot exceed the length of the transect and does not include overlap of the same item along the transect.

Required.
Accuracy Standards = ± 5 percent.

LINE INTERCEPT SUMMARY
(R2-2200-LISum)

F1-7: F S -- 0 2 -- 0 4 -- 0 9 -- 9 4 -- M B -- 0 8 2

Plot ID Agency Region Forest District Year Exam'r Plot Number

F8: 2 Number of Transects F9: 1 0 0 Transect Length

	F10 LF	F11 Plant Name	F12 A/S	F13 T1	F14 T2	F15 T3	F16 T4	F17 T5	F18 T6	F19 T7	F20 T8	F21 T9	F22 T10	Ave Intcpt
1	S	ARTRV	MS	18	12									15
2	S	SYRO	MS	8	14									11
3	S	ROWO	MS	2										1
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														

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SHRUB DENSITY AND AGE/FORM CLASS
R2-2200-SD

GENERAL DISCUSSION

Shrub density data can be used to supplement data collected with other inventory or monitoring methods, or be used by itself depending on the objectives. It should not be employed as the sole basis for inventory but may be used with or in lieu of the line intercept procedure. The technique provides plant (shrub) species density along with information on the form and age class of the various shrubs present. This information provides additional data for evaluating condition or trend in the shrub community, and is especially important where some form of cultural treatment has been done and/or where the shrub component is important.

ADVANTAGES AND LIMITATIONS

Shrub density information is relatively easy and quick to obtain. In shrub plant communities this information can be collected on the same transect as for cover-frequency, line intercepts, or rooted nested frequency. The collected data provides additional information to the range manager about changes in the shrub component of the plant community.

SAMPLING PROCEDURE

Measurements for this procedure can be taken in conjunction with other trend transects. Measurements are taken along the whole 100-foot transect creating a sample area 100 feet long and 3 feet wide. A similar type study area can be independently set up if measurements are not made in conjunction with frequency belts.

All shrubs (or measured plants) encountered along the transect are dot tallied by species and classified according to form and age class. The Shrub Density Data Form (R2-2200-SD) is used to record this information.

FORM DESCRIPTION

Tally the age and form class information on the Shrub Density Form (R2-2200-SD).

FIELDS 1-7: RECORD IDENTIFIER (15-CHAR)

Enter the Key ID identified in fields 1-7 of the General Field Data Form (R2-2200-GF).

Required.
Accuracy Standards = No Errors.

FIELD 8: NUMBER OF TRANSECTS (2-NUM)

Identify which transect this form is for by idenitfying transect number "x" of "y" where "x" is the transect number and "y" is the total number of transects in the sample, usually one and sometimes as many as two or three. This number cannot exceed ten.

Required.
Accuracy Standards = No Errors.

FIELD 9: TRANSECT LENGTH (3-NUM)

Enter the total length of the transect. The standard length for the Rocky Mountain Region is 100 feet.

Required.
Accuracy Standards = No Errors.

SPECIES 1-5 (8-CHAR)

Enter the species code of the plants encountered on the line intercept. Use more than one form if necessary.

Required.
Accuracy Standards = No Errors.

AGE CLASSES

To assure consistency in classifying and recording shrubs by form and age class, the following definitions should be used:

SEEDLING (SPROUTS) (S)

A very young plant which has become firmly established yet obviously is a newcomer on the site (first-year seedlings are ignored). It is usually distinguished by its relatively small size, generally single stem, simple or no branching, succulent bark, less than 1/8-inch diameter at the base, and does not possess a large root stock (sprouts may be an exception). No evidence of flowering or seed production.

YOUNG (Y)

A relatively young plant, larger than a sprout or seedling (1/8-inch to 1/2-inch diameter at the base, varying with species) with more complex branching, may possess multiple basal stems but is attached to a relatively small root stock (except for saplings), and bark is more fibrous than seedlings but is not fissured as with a mature plant. Crowns are not rounded and are made up of all living wood. May or may not show signs of flowering and seed production.

MATURE (M)

A mature plant exhibits complex branching and multiple stems, fibrous fissured bark, rounded growth form, large, heavy, often gnarled stems and a firmly established predominant root stock. The root crown is made up of three-quarters or more living wood. Evidence of flowering and or seed production is present.

DECADENT (D)

A mature plant which possesses more than 50 percent dead wood in the crown.

DEAD (X)

A plant which obviously does not possess any live crown, but the root is still firmly attached (downed, unattached, woody stems are considered litter).

FORM CLASSES

The form classes are based on availability of browse plants and their degree of hedging. These factors along with age structure can assist in determining the relative health of a browse stand and can aid in evaluating trend.

Availability represents the relative amount of twig growth which is within reach of grazing animals. Snow depth or duration will have no bearing on availability, as defined in this Guide. Hedging is the result of repeated utilization and is one of the factors which affects availability of shrubs. The general appearance of the plant is a primary criteria in determining degree of hedging.

The following descriptions are provided as an aid to classifying shrub availability.

ALL AVAILABLE

This category signifies that all of the current year's twig growth is within reach of grazing animals. This type of plant is generally represented by an open crown.

LARGELY AVAILABLE

The bulk of the vegetation in this category is available to the class of herbivores present in the area. A small portion of the current year's growth is unavailable due to:

- large crowns,
- moderate to heavy hedging,
- shrub height,
- steep terrain, and
- stand density.

MOSTLY UNAVAILABLE

A large portion of current year's growth is not available for grazing. This may be due to one or more of the reasons mentioned in the largely available category above.

UNAVAILABLE

These shrubs may produce large quantities of twig growth; however, it is not available to grazing animals. Frequently, a tall growth form places shrubs in this category. A hedgeline is also common where shrubs have become unavailable. Dead or decadent plants often fall in this category.

HEDGING CATEGORIES

Within the "all available" and "largely available" form classes, indicate the status of the hedging with one of the following categories.

LIGHTLY HEDGED

Shrubs of this nature generally have open, loose crowns and produce a large quantity of vigorous twigs. Frequently, these plants are either all or largely available. Their appearance is that of healthy, fast-growing plants. Unhedged plants are included here.

MODERATELY HEDGED

These shrubs possess moderately open crowns but show signs of some clubbing. Plants which are hedged to this degree exhibit varying levels of vigor and begin to take on a ragged appearance. Some of the twigs are readily available while the remaining twig growth is generally unavailable due to the tight growth forms and presence of larger clubbed stems on the periphery of the crown.

CLOSELY HEDGED

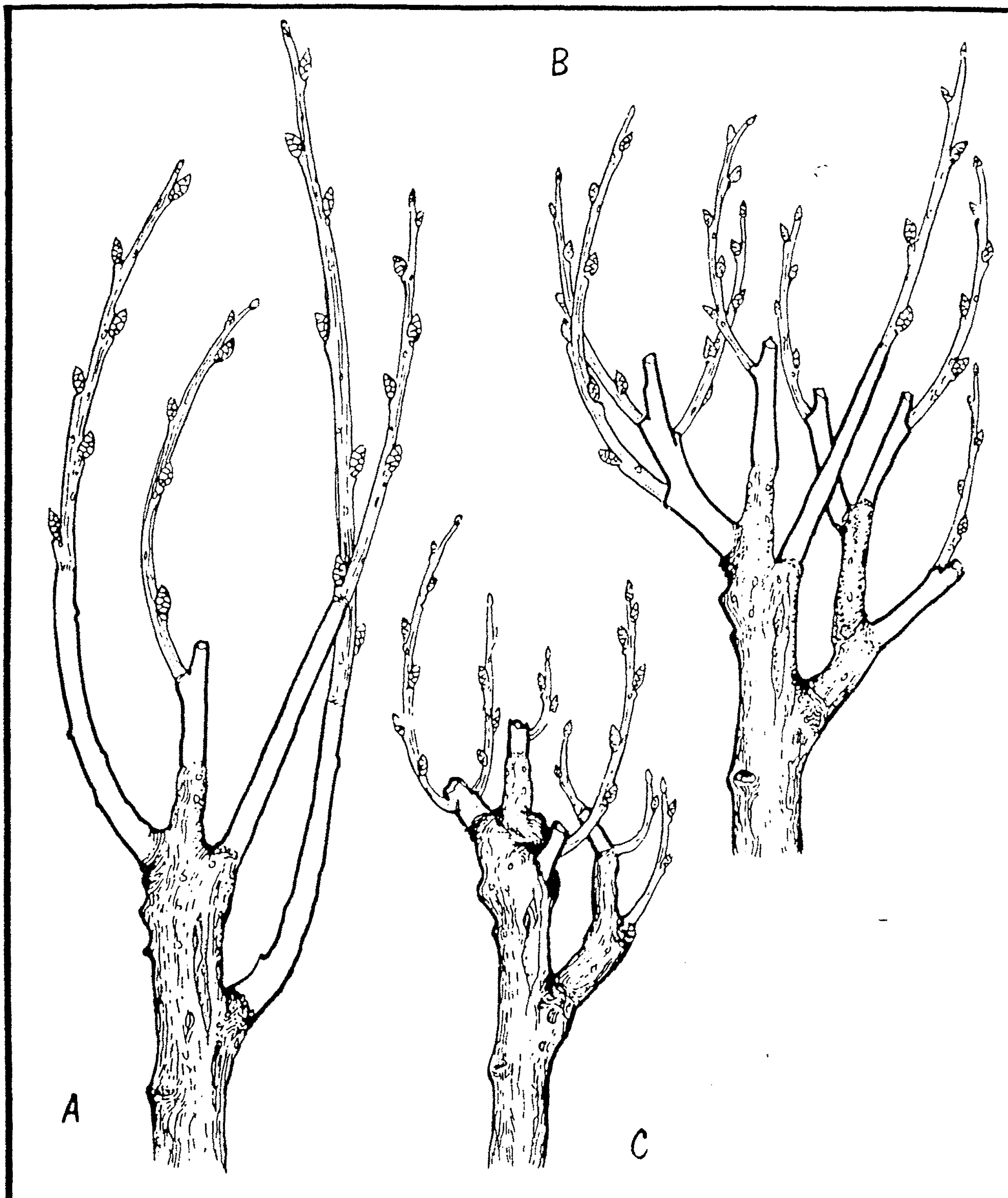
A closed, compact rounded appearance is usually characteristic of this degree of hedging on a mature plant. Generally, very little twig growth is present on the exterior portion of the shrub; most of the twig growth is confined to the interior.

A decadent plant often shows signs of close hedging on the few larger stems which produce limited leader growth. Young plants are generally not very common in a closely-hedged shrub community. A diagram of hedging classes is shown in Figure 3-15.

SHRUB DENSITY DATA SUMMARY

The summary is merely a total of the dot tallies per area measured and recorded for each individual species on each transect. These totals can subsequently be compared with previous or subsequent measurements of the same stand.

Figure 3-15. DEGREE OF HEDGING



A. Zero to light, B. Moderate, C. Severe

SHRUB DENSITY
(R2-2200-SD)

F1-7: F S -- 0 2 -- 0 4 -- 0 9 -- 9 4 -- M B -- 0 8 2

Plot ID	Agency	Region	Forest	District	Year	Exam'r	Plot Number
F1-7:	F S	0 2	0 4	0 9	9 4	M B	0 8 2

F8: Transect: 1 of 2 F9: 1 0 0 Transect Length

AGE CLASS

	SPECIES:	ARTRV	SYOR	ROWO		
Seedling Sprout	S	2	1			
Young Sapling	Y					
Mature	M	7	3	1		
Decadent	D					
Dead	X					

FORM CLASS (w/ hedging categories)

		ARTRV	SYOR	ROWO		
All Available	Lightly Hedged	9	4			
	Moderately Hedged					
	Closely Hedged					
Largely Available	Lightly Hedged					
	Moderately Hedged					
	Closely Hedged					
Mostly Unavailable						
Unavailable						

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PRODUCTION MEASUREMENTS
R2-2200-PD

GENERAL DISCUSSION

As part of both inventory and monitoring, a key measurement is forage production. A forage production estimate should be made for each CVU. In addition to total forage production, data can be collected by selected species or life form as needed. The most practical way to do this is a combination of clipping and weighing forage and then using that measurement to calibrate ocular estimates to expand the sample size. Production measurements are normally optional. The exception is when capacity is being determined for the first time. Then it is important to measure the production.

TRAINING

Examiners must be knowledgeable in plant identification. In addition, they must be experienced in providing ocular estimates of production data.

PERSONNEL AND EQUIPMENT

Equipment required for this sampling method includes the appropriate plot frame (see Table 3-8), a gram scale, clippers, and paper bags. Use the Production Data Form (R2-2200-PD) for sampling and calculating production. *NOTE: Circular plots of 9.6 feet*^{2} *should be used to sample sparsely vegetated sites; 0.96 feet*^{2} *circular plots should be used on densely vegetated sites.*

SAMPLING PROCEDURE

This method is applicable for both grazed and ungrazed areas. It is preferable to estimate production in ungrazed areas.

CLIPPING AND WEIGHING

Forage will be clipped as close to the ground as possible, and weighed using a gram scale. Frame sizes and conversion factors are provided (Table 3-8). All production estimates should be corrected to give air-dry forage produced. Table 3-9 provides factors for converting green, field weights to air-dry weights. When precise production measurements are required, air-dry the clipped vegetation and do not use the conversion factors in Table 3-9.

Actual air-dry measurements are much more accurate than using conversion factors. Typically all forage species are lumped together to get a total forage production estimate for carrying capacity determinations. There may be times when plants are separated by species or life form to meet specific management needs.

Table 3-8. PRODUCTION CONVERSION FACTORS

Plot frame			Multiply grams weighed in order to determine:[9]	
			lbs/ac	kg/ha
Rectangle:	20x50 cm.	(.1 m^2)	89.2	100.0
Square:	50x50 cm.	(.25 m^2)	35.7	40.0
Circle:	radius 6.6 in	(0.96 ft^2)[10]	100.0	112.9
Circle:	radius 21.0 in	(9.6 ft^2)[11]	10.0	11.2

To determine forage production on grazed areas, it is necessary to adjust the estimate of forage remaining by the degree of utilization. This is done by using the following equation:

$$\frac{\text{Weight of Forage Remaining (lbs/ac)}}{\text{Estimated Percent Remaining (use decimal)}} = \text{Total Production}$$

After a minimum of training, reliable ocular estimates of relative forage production can be obtained.

ROBEL POLE USE

Visual readings from a Robel pole can be correlated to forage production or standing crop by clipping and weighing forage on a sample after making the Robel pole readings. Care must be taken to understand that use of a pole will provide an estimate of *standing biomass*. This will include not only this year's production, but also any herbage remaining from prior years. After the correlation is made between the Robel pole reading and production, the Robel pole can be used to quickly and efficiently expand the sample size for production on a specific plant community. (Reference the Robel pole section in the Monitoring Chapter, page 4-29.) This method has a lot of potential for National Forest rangelands and will be the focus of research studies in the near future.

[9] g/ha x .9 = lbs/ac

[10] The 0.96 ft^2 circle can be constructed by using 41.7in of cable.

[11] The 0 9.6 ft^2 circle can be constructed by using 131.8in of cable.

Table 3-9 PERCENTAGE OF AIR-DRY MATTER IN HARVESTED PLANT MATERIAL AT VARIOUS STAGES OF GROWTH

SHRUBS	**New leaf/twig growth until leaves full size**	**Older and full-size green leaves**	**Green fruit**	**Dry fruit**	
Evergreen big sagebrush, bitterbrush	55%	65%	35%	85%	
Deciduous snowberry, rabbitbrush, snakeweed, Gambel oak	35%	50%	30%	85%	
Yucca and Yucca-like plants	55%	65%	35%	85%	
FORBS	**Initial growth to flowering**	**Flowering to seed maturity**	**Seed ripe; leaf tips dry**	**Leaves dry; stems drying**	**Dry**
Succulent violet, cow parsnip, waterleaf, buttercup, bluebells, ligusticum, sweet-anise, onion, lilies, monkshood	15%	35%	60%	90%	100%
Leafy lupine, balsamroot, and others	20%	40%	60%	90%	100%
Fibrous leaves or mat phlox, pussytoes, mat eriogonum	30%	50%	75%	90%	100%
GRASSES	**Before heading; initial growth to boot stage**	**Headed out; boot stage to flowering**	**Seed ripe; leaf tips dry**	**Leaves dry; stems partly dry**	**Apparent dormancy**
Cool Season wheat grasses, perennial bromes, bluegrasses, needlegrasses, prairie junegrass	35%	45%	60%	85%	95%
Warm Season Tall grasses big bluestem, indiangrass, switchgrass	30%	45%	60%	85%	95%
Mid grasses side-oats grama, little bluestem, galleta	40%	55%	65%	90%	95%
Short grasses blue grama, buffalograss, short tree-awn	35%	45%	60'%	85%	95%

FORM DESCRIPTION
R2-2200-PD

If production plot frames are sampled along transects, the field form (R2-2200-PD) allows no more than 20 plot frames per transect to be recorded. Each page of Form R2-2200-PD accommodates up to 30 items; however, the data base can accommodate as many entries as you require. Use as many pages of Form R2-2200-PD as you need to record all the items of interest to your study.

FIELDS 1-7: RECORD IDENTIFIER (15-CHAR)

Enter the Key ID identified in Fields 1-7 of the General Field Data Form (R2-2200-GF).

Required.
Accuracy Standards = No Errors.

FIELD 8: NUMBER OF TRANSECTS (2-NUM)

Identify which transect this form is for by idenitfying transect number "x" of "y" where "x" is the transect number and "y" is the total number of transects in the sample, usually one and sometimes as many as two or three. This number cannot exceed ten.

Required.
Accuracy Standards = No Errors.

FIELD 9: NUMBER OF FRAMES PER TRANSECT (2-NUM)

Enter the number of plot frames used to record production along a transect. This number cannot exceed 20, and must be the same for each transect.

Required.
Accuracy Standards = No Errors.

FIELD 10: FRAME SIZE (4-NUM)

Enter the size of the plot frame used in production sampling to the nearest 0.01 square foot. For example, a circular plot of 4.8 $feet^2$ would be entered as "048".

Required.
Accuracy Standards = No Errors.

CONVERSION FACTOR (4-NUM)

Enter the conversion factor from Table 3-8, based on the frame size.

Optional.
Accuracy Standards = No Errors.

FIELD 11: LIFE FORM (1-CHAR)

Enter one of the following codes to describe the correct life form for each plant species, genus, or life form being sampled. *NOTE: This field cannot be left blank during data entry.*

CODE	LIFE FORM
T	tree (includes conifer and broadleaf trees)
S	shrub (includes woody stemmed vines and subshrubs)
G	graminoid
F	forb
E	fern/allies (includes *Lycopodium* and *Selaginella*)
M	moss
L	lichen
U	fungus
A	alga
Z	not applicable

Required, for plant species.
Accuracy Standards = No Errors.

> *NOTE: Whenever a plant species code (or symbol) is required, use the 8-character alpha-numeric codes from the standard Soil Conservation Service's PLANTS data base. Lists of all species by state are available from the Forest botanist, ecologist, or soil scientist.*

FIELD 12: SPECIES (8-CHAR)

The production data base can accommodate as many items as were sampled on as many as 10 transects, even though the field form only allows 25 entries per page. Use as many pages of R2-2200-PD as you need to record all items of interest. If an item is encountered on at least one transect, ensure that it is consequently recorded on all other transects even though its production may only be "0".

If more than one transect is sampled, enter plot frames in consecutive order by transect and use a separate R2-2200-PD for each transect. A maximum of 20 plot frames may be sampled on each transect.

Required.
Accuracy Standards = No error in species level identification for dominant, common, ecological indicator plants.

FIELD 13: AGE OR SIZE CLASS CODES (2-CHAR)

Enter one of the following codes to describe the age or size class of an item recorded in Field 12.

LIFE FORM	CODE	COLUMN DESCRIPTION
Coniferous Tree Species	SE	Seedling trees (< 1.0 in DBH or < 4.5 ft tall)
	SA	Sapling trees (1.0 - 4.9 in DBH)
	PT	Pole trees (5.0 - 8.9 in DBH)
	ME	Medium tree (9.0 - 15.9 in DBH) dominated
	LA	Large tree (16.0 - 32.9 in DBH) dominated
	VL	Very large tree (> 33.0 in DBH) dominated
Broadleaf Tree Species	LL	Lower layer seedlings, sprouts, and saplings (< 2.5 ft tall)
	ML	Middle layer sprouts & saplings (2.5 - 6.5 ft tall)
	SP	Sapling and pole trees (≥ 6.5 ft tall and ≤ 8.9 in DBH)
	ME	Medium tree (9.0 - 15.9 in DBH) dominated
	LA	Large tree (16.0 - 32.9 in DBH) dominated
	VL	Very large tree (> 33.0 in DBH) dominated
Shrub Species Size Class	LS	Lower layer (≥ 1 yr old and < 2.5 ft tall)
	MS	Middle layer (2.5 - 6.5 ft tall)
	TS	Upper layer (≥ 6.5 ft tall)
Herbaceous or Shrub Species Age Class	SE	Seedlings (< 1 yr old)
	RS	Regrowth and sprouts (< 1 yr old)
	YO	Young (≥ 1 yr old without accumulate litter and < 10% dead material)
	MA	Mature (accumulated litter present and dead material present is 10-30%)
	DE	Decadent (≥ 30% dead material)

This field allows the examiner to distinguish between age or size classes for the same item by providing a separate line of data for different age or size classes. Item names may be repeated, therefore, only if the accompanying age/size classes differ. Other classes may be substituted for age or size class, such as categories for structure or phenology. Such classes must be specific to a given study and should be recorded in the appropriate project file, as well as noted on the Comments Form (R2-2200-CD).

Optional.
Accuracy Standards = No Errors.

PRODUCTION DATA

For each plot frame use a bag, gram scale, and clippers to weigh units of green (current year's growth) above ground biomass by item. Estimate the grams green weight, by item, for the whole plot frame. All green biomass that hangs over the plot frame is included in such estimates. Tree and shrub biomass above 6.5 feet height is not included in production estimates.

Individual plot frame green weight production data are not entered into the data base. They are converted to dry weight values as described in Table 3-9 and entered in fields 15-24. Enter dry weight values in these fields if actual dry-weight measurements are made.

Required.
Accuracy Standards* = ± *10 percent.

AVERAGE GREEN WEIGHT

Total the green weight values for all plot frames, divide by the total number of plot frames on the transect (field 9), and enter the value in this field.

Required.
Accuracy Standards* = ± *10 percent.

DRY WEIGHT FACTOR

Enter an appropriate dry weight factor (that is, decimal between 0 and 1) to convert plot frame green weight estimates (GW) to dry weight by item. Dry weight factors are provided by life form in Table 3-9. If the same dry weight factor is used for an item over all the plot frame sampled, enter it once in the space provided for the first plot frame. If actual dry-weight measurements are made, enter "1.00" in this field

Optional.
Accuracy Standards = Good Judgment.

FIELDS 15: AVERAGE TOTAL PRODUCTION (4-NUM)

Enter the average measured, or converted, dry weight production (in grams) for each item. Dry weight is obtained by multiplying the average green weight (GW) by the appropriate dry weight conversion factor (DWF).

Required.
Accuracy Standards* = ± *10 percent.

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PRODUCTION DATA
(R2-2200-PD)

F1-7: **F S -- 0 2 -- 0 4 -- 0 9 -- 9 4 -- M B -- 0 8 2**

Plot ID Agency Region Forest District Year Exam'r Plot Number

F8: Transect: __1 of __2 F9: Frames/Transect: 2 0 F10: Frame Size: __ __ . 9 6 Conversion Factor: 1 0 0 . 0

	F11	F12	F13																					Average		F15
	LF	Species	A/S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	GW	DWF	Ave. Prod.
1	G	GRASS	MA	48	92	67	31	40	35	59	80	16	59	45	82	60	45	49	51	62	28	42	91	54	0.6	32
2																										
3																										
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Total Prod	32
Conv Factor	x 100
Total lbs/acre	3200

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FORM DESCRIPTION R2-2200-PDSUM

There is room for 39 species on summary form R2-2200-PDSum; however, there is no limit to the number of items that can be sampled and entered into the data base. Consequently, use as many copies of this form as needed to report all the items of interest in the study. The information from the R2-2200-PD Form is summarized on this form. It is this form that is used for data entry into the data base.

FIELDS 1-7: RECORD IDENTIFIER (15-CHAR)

Enter the Key ID identified in fields 1-7 of the General Field Data Form R2-2200-GF).

Required.
Accuracy Standards = No Errors.

FIELD 8: NUMBER OF TRANSECTS (2-NUM)

Identify the total number of production transects taken on this sample. The total number of transects in the sample is usually one and sometimes as many as two or three. This number cannot exceed ten.

Required.
Accuracy Standards = No Errors.

FIELD 9: FRAME SIZE (4-NUM)

Enter the size of the plot frame used in production sampling to the nearest 0.01 square foot. For example, a circular plot of 4.8 square feet would be entered as"048".

Required.
Accuracy Standards = No Errors.

FIELD 10: LIFE FORM (1-CHAR)

Enter one of the following codes to describe the correct life form for each plant species.

CODE	LIFE FORM
T	tree (includes conifer and broadleaf trees)
S	shrub (includes woody stemmed vines and subshrubs)
G	graminoid
F	forb
E	fern/allies (includes *Lycopodium* and *Selaginella*)
M	moss
L	lichen
U	fungus
A	alga
Z	not applicable

Required.
Accuracy Standards = No Errors.

> *NOTE: Whenever a plant species code (or symbol) is required, use the 8-character alpha-numeric codes from the standard Soil Conservation Service's PLANTS data base. Lists of all species by state are available from the Forest botanist, ecologist, or soil scientist.*

FIELD 11: ITEM (8-CHAR)

The Production data base can accommodate all items sampled on as many as 10 transects, even though the field form only allows 25 entries per page. Use as many pages of Form R2-2200-PD as needed to record all items of interest in sampling.

During the transition period between using other species coding systems and the SCS PLANTS data base codes, it is advisable to make a note as to the scientific name. This is particularly important for graminoids, forbs, and some shrubs, especially where there is a high probability that the code species symbol can be confused for more than one species.

Required.
Accuracy Standards = No error in species level identification for dominant, common, or habitat type indicator plants.

FIELD 12: AGE OR SIZE CLASS CODES (2-CHAR)

Enter one of the following codes to denote the age or size class of an item in line intercept sampling.

LIFE FORM	CODE	COLUMN DESCRIPTION
Coniferous Tree Species	SE	Seedling trees (< 1.0 in DBH or < 4.5 ft tall)
	SA	Sapling trees (1.0 - 4.9 in DBH)
	PT	Pole trees (5.0 - 8.9 in DBH)
	ME	Medium tree (9.0 - 15.9 in DBH) dominated
	LA	Large tree (16.0 - 32.9 in DBH) dominated
	VL	Very large tree (> 33.0 in DBH) dominated
Broadleaf Tree Species	LL	Lower layer seedlings, sprouts, and saplings (< 2.5 ft tall)
	ML	Middle layer sprouts & saplings (2.5 - 6.5 ft tall)
	SP	Sapling and pole trees (≥ 6.5 ft tall and ≤ 8.9 in DBH)
	ME	Medium tree (9.0 - 15.9 in DBH) dominated
	LA	Large tree (16.0 - 32.9 in DBH) dominated
	VL	Very large tree (> 33.0 in DBH) dominated
Shrub Species Size Class	LS	Lower layer (≥ 1 yr old and < 2.5 ft tall)
	MS	Middle layer (2.5 - 6.5 ft tall)
	TS	Upper layer (≥ 6.5 ft tall)
Herbaceous or Shrub Species Age Class	SE	Seedlings (< 1 yr old)
	RS	Regrowth and sprouts (< 1 yr old)
	YO	Young (≥ 1 yr old without accumulate litter and < 10% dead material)
	MA	Mature (accumulated litter present and dead material present is 10-30%)
	DE	Decadent (≥ 30% dead material)

This field allows the examiner to distinguish between age or size classes for the same item by providing a separate line of data for different age or size classes. Item names may be repeated only if the accompanying age/size classes differ. Other classes may be substituted for age or size class, such as categories for structure and hardness of snags or downed logs. Such classes must be specific to a given study and should be recorded in the appropriate project file as well as noted on the Comments Form (R2-2200-CD).

Optional.
Accuracy Standards = No Errors.

FIELDS 13-22: PRODUCTION DATA BY TRANSECT (10 3-NUM)

Enter the dry weight production for each plant species (item) on each of a maximum of 10 transects. Enter production values in grams (from field 15 of R2-2200-PD).

Required.
Accuracy Standards = ± ***10 percent.***

PRODUCTION DATA SUMMARY (R2-2200-PDSum)

F1-7: F S -- 0 2 -- 0 4 -- 0 9 -- 9 4 -- M B -- 0 8 2

Plot ID Agency Region Forest District Year Exam'r Plot Number

F8: __ 2 Number of Transects F9: __ __ . 9 6 Frame Size

	F10 LF	F11 Item	F12 A/S	F13 T1	F14 T2	F15 T3	F16 T4	F17 T5	F18 T6	F19 T7	F20 T8	F21 T9	F22 T10	Ave Prod
1	G	GRASS	MA	3200	2100									2650
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PARKER VEGETATION DATA

In general, the Parker Three-Step Method (Parker, 1949) was the only vegetative method approved for use in the Rocky Mountain Region for many years. It is the consensus among range professionals that methods such as cover-frequency, line intercept and rooted nested frequency provide more accurate data. Use of the Parker Three-Step Method will be phased out in the Rocky Mountain Region.

Although the data obtained from the Parker transects does not meet current needs, the transect photograph records are invaluable to demonstrate vegetative changes over time. Some of the permanent transects should be retained for this reason.

Each permanent Parker transect should be carefully evaluated to determine if it is properly located and provides a truly representative sample of the surrounding ecological type. If the transect is judged to be valuable for retention, it is suggested that the transect be reread using the Parker method first.[12] In this fashion, Parker vegetation data can eventually be correlated with ecological status and resource value ratings. In order to transition to current methods, superimpose a standard cover-frequency transect along the same 100-foot transect.

If the transect is judged to not be suitable for future condition and trend ratings, the transect should not be resampled. However, it is valuable to retake the transect photographs and maintain the permanent transect location information and photos in the permanent allotment file folder. Indicate whether the old transect location should be revisited, and at what interval.

[12] Refer to the 1985 Range Analysis and Management Handbook, FSH 2209.21 for instructions. Data will be recorded on Form R2-2200-11.

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GENERAL FIELD DATA
R2-2200-GF

GENERAL DESCRIPTION

General field data are the minimum pieces of information that tie all samples from all sources together. It is support and supplemental data important to many different resources and uses. Therefore, the General Field Form will be completed for every plot, regardless of permanence, or inventory or monitoring purpose. The data on this form meets one or both of two criteria:

- It is the generic, common data that is always collected. For example, examiner identification, plot location, and site data.
- It is the minimal amount of information that virtually insures all plots can be later stratified for a variety of purposes. For example, general vegetation description, fuel loading, and disturbance events.

Infrequently, only general field data may be collected on a site. This may be done as a reconnaissance (or "walk-through") plot only. Again, the stratifying characteristics come into play, as do the spatial grouping aspects.

TRAINING

Training required to complete a General Field Form is minimal. A basic understanding of natural resource inventory methods is sufficient.

PERSONNEL AND EQUIPMENT

One person can complete a General Field Form in approximately 15 minutes. The process will become more efficient with practice. The equipment required for completing this form includes: altimeter or quality topographic quad map with photo(s), compass, clinometer or Relaskop, 6-foot tape measure calibrated in tenths and hundredths of feet, and camera. Use of a GPS unit is strongly encouraged.

SAMPLING PROCEDURE

It is recommended that this Form be completed after all other inventory methods are done, especially with respect to the existing and potential vegetation components. There are certain components of this form that can be filled out while the inventory is being conducted. Experience will help the examiner determine the most efficient sequence to complete the form.

If general field data remains constant from one sample to the next, the information can be copied as such. Be careful, however, to ensure that the data is in fact the same. Some variables, such as elevation, aspect, and slope, may be slightly different; it is important to capture the variability in these attributes for each sample. Do not accelerate the information gathering process at the expense of data quality.

RECORD IDENTIFIER

The Record Identifier is a combination of alpha-numeric characters which uniquely identifies each plot. It is a combination of fields 1-7 and has a unique value across districts, forests, regions, and agencies. Consequently data from different sources can be shared without generating confusion. The complete name of the examiner(s) and the complete data are also included.

> *NOTE: It is important that each and every sample -- regardless of sampling method -- be assigned a unique Record Identifier. That number maintains the integrity of each sample in the field on paper, as well as into the data base, regardless of what data base is used. A unique record identifier must be assigned to each sample, regardless of the number of samples within a polygon.*

FIELD 1: AGENCY (2-CHAR)

Describe the agency or unit conducting the study with one of the following codes. The spatial location of the plot will determine ownership and management responsibility. For additional codes coordinate with the Regional Office, Renewable Resources Staff.

CODE	DESCRIPTION
AR	Agricultural Research Station
BI	Bureau of Indian Affairs (USDI)
BL	Bureau of Land Management (USDI)
FG	State Fish and Game Department
FR	Forest Service Research (USDA)
FS	Forest Service
FW	Fish and Wildlife Service (USDI)
FX	Forest Service -- Stand Exam Plot (USDA)
NC	The Nature Conservancy
NP	National Park Service (USDI)
PV	Other private lands
SC	Soil Conservation Service (USDA)
SL	Department of State Lands
UR	University Research
OT	Other (explain in Comments, Form CD)

Required.
Accuracy Standards = No Errors.

FIELD 2: REGION OR STATE (2-CHAR)

Forest Service personnel enter a 2-digit number to describe the appropriate Region (for example, Rocky Mountain Region = "02"). Other agencies may establish their own administrative unit or state designators. For example, enter the 2-character Postal Service abbreviation for the state (for example, Wyoming = "WY"). Use "UN" when the region or state is unknown.

Required.
Accuracy Standards = No Errors.

FIELD 3: NATIONAL FOREST (2-CHAR)

Enter the number for the National Forest conducting the study. (See page 3-116 for Rocky Mountain Region codes.) Non Forest Service users may utilize their own coding conventions, for example, designator for BLM District, unit designator within a state game and fish agency or county designator. Enter "XX" if there is no appropriate code for this field.

Required.
Accuracy Standards = No Errors.

FIELD 4: RANGER DISTRICT (2-CHAR)

Enter the number corresponding to the Ranger District conducting the study. Non Forest Service users may utilize their own coding conventions in this subfield, for example, designator for BLM Area. Enter "XX" if there is no appropriate code for this field.

CODE	UNIT	CODE	UNIT	CODE	UNIT
02	**Bighorn NF**	**03**	**Black Hills NF**	**04**	**Grand Mesa-Uncompahgre -Gunnison NFs**
01	Buffalo RD	01	Bearlodge RD	01	Collbran RD
03	Medicine Wheel RD	03	Custer RD	02	Grand Junction RD
04	Paintrock RD	04	Elk Mountain RD	05	Norwood RD
05	Tensleep RD	06	Harney RD	06	Ouray RD
06	Tongue RD	08	Nemo RD	07	Cebolla RD
		09	Pactola RD	08	Paonia
		11	Spearfish RD	09	Taylor River RD
06	**Medicine Bow NF**	**07**	**Nebraska NF**	**09**	**Rio Grande NF**
02	Brush Creek RD	01	Bessey RD	03	Conejos Peak RD
04	Hayden RD	02	Pine Ridge RD	04	Creede RD
05	Laramie RD	05	Fall River RD	05	Del Norte RD
09	Douglas RD	06	Wall RD	06	Saguache RD
10	**Arapaho-Roosevelt NFs**	**11**	**Routt NF**	**12**	**Pike-San Isabel NFs**
01	Boulder RD	01	Bears Ears RD	01	Leadville RD
04	Estes-Poudre RD	03	Hahn's Peak RD	02	Salida RD
05	Redfeather RD	04	North Park RD	03	San Carlos RD
06	Pawnee NG	05	Yampa RD	06	Comanche NG
07	Clear Creek RD	06	Middle Park RD	07	Cimarron RD
08	Sulphur RD			09	Pikes Peak RD
				10	South Park RD
				11	South Platte RD
13	**San Juan NF**	**14**	**Shoshone NF**	**15**	**White River NF**
01	Animas RD	01	Clarks Fork RD	01	Aspen RD
02	Dolores RD	02	Greybull RD	02	Blanco RD
03	Mancos RD	03	Lander RD	03	Sopris RD
06	Pagosa RD	04	Wapiti RD	04	Eagle RD
08	Pine RD	05	Wind River RD	07	Holy Cross RD
				08	Rifle RD
				10	Dillon RD

Required.
Accuracy Standards = No Errors.

FIELD 5: YEAR (2-NUM)

Enter the last two calendar year digits (for example, 1990 = "90").

Required.
Accuracy Standards = No Errors.

FIELD 6: EXAMINER (2-CHAR)

Enter a 2-character alpha-numeric combination for the examiner or crew. The examiner code must be unique within a District and for each year of sampling. A record of the examiner's name and unique identifier should be kept in the project file. It is very important that Forest and District inventory coordinators insure there are no duplicate 15-character plot numbers within any given year of sampling. The best way to insure this is to assign unique examiner codes to each individual working on a district each year. The examiner has responsibility for sequentially numbering their plots collected on a district in a given year. If absolutely necessary, two different examiners may use the same examiner code, but they must be sure they do not use identical plot numbers (field 7).

> *NOTE: Do not use the number '0' or letters 'O,' 'X,' or 'Z' as these characters are used to indicate plots constructed from stand exam data ("XX"), historic plots (data collected prior to 1900), or plots based on output from models. The later types of plots will only be stored temporarily.*

Required.
Accuracy Standards = No Errors.

FIELD 7: PLOT NUMBER (3-NUM)

Enter a plot number that is unique by examiner and year. Enter sequential plot numbers for each examiner within the calendar year, up to 999. If one examiner establishes more than 999 plots in one year, a new examiner code should be assigned and the individual encouraged to take a vacation.

Required.
Accuracy Standards = No Errors.

An example of a complete record identifier (Key ID) follows. The 45th plot taken by Guinea Pig (Mr. Pig is given the unique examiner code of "GP") on the Pike-San Isabel NF, South Park RD during calendar year 1994, would be entered as:

FS 02 12 10 94 GP 045

As described above, a new, unique plot number should be assigned to each and every sample. This is imperative in managing and using the information.

FIELD 8-10: NAME OF EXAMINER(S) (20-CHAR)

Enter the last name, first name, and middle initial of all parties collecting data. List the crew leader first. This should be the same person identified by the Examiner Code (field 6) in the record identifier.

Required.
Accuracy Standards = No Errors.

FIELD 11: MONTH (2-NUM)

Enter one of the following calendar month codes for the sampling date.

CODE	MONTH	CODE	MONTH
01	January	07	July
02	February	08	August
03	March	09	September
04	April	10	October
05	May	11	November
06	June	12	December

Required.
Accuracy Standards = No Errors.

FIELD 12: DAY (2-NUM)

Enter the sampling date.

Required.
Accuracy Standards = No Errors.

FIELD 13: CENTURY (2-NUM)

Enter the first two digits of the century, for example "19". (This value has been pre-entered on the form.)

Required.
Accuracy Standards = No Errors.

SAMPLING SYSTEM DATA

This grouping of information (fields 14-39) describes the sampling system being used. It includes a list of sample forms completed on the plot, plot dimension information, and any permanent or comparison plots.

FIELDS 14-33: SAMPLE FORMS

Various types of sampling procedures may be used to describe characteristics of the site being sampled (for example, soil pedon description or foliar line intercept cover). Identify the different types of sampling methods utilized at your plot by circling the appropriate codes. ***The coding conventions used below correspond to the sampling method's field form identification.*** Identifying the field forms aids data entry and maintaining the paper record of the sample(s).

CODE	DESCRIPTION
CD	Comments Data
CF	Cover/Frequency Data
CS	Cross-Section Composition Data
GL	Green-Line Transect Data
HU	Herbage Left Ungrazed Data
LI	Line Intercept Cover Data
OP	Ocular Plant Composition Data
PD	Production Data
PU	Production Utilization Data
RN	Rooted Nested Frequency Data
SD	Shrub Density Data
SH	Stubble Height Data
UG	Utilization Gauge Data
US	Utilization Study -- Paired Plot Data
VO	Visual Obstruction Data
WS	Woody Species Regeneration Data
NA	Not Applicable

For example, a site on which a cover-frequency transect, a line intercept transect, a shrub density sample, and a stubble height sample were conducted, along with several lines of comments would have the CF, LI, SD, SH, and CD codes circled. The General Field Data Form (R2-2200-GF) is always completed for a site. Consequently, GF does not need to be recorded here. This field cannot be left blank during data entry.

Required.
Accuracy Standards = No Errors.

FIELD 34: UNIT OF MEASUREMENT (1-CHAR)

This unit of measurement flag is with respect to ocular observations (plant composition method) and for completing the General Field Form. Enter one of the following codes to describe if the units of measurement being entered are english (E) or metric (M). Units of measurement are specified for other sampling methods on the forms for those sampling methods. Different sized plots may be used for sampling live versus dead trees. Use field 34a for the live tree plot and field 34b for the dead tree plot.

Required.
Accuracy Standards = No Errors.

FIELD 35: PLOT RADIUS OR LENGTH (3-NUM)

This describes the plot size used to complete the General Field Data Form (R2-2200-GF). If an ocular plant composition plot is done, it also describes the plot size for the Ocular Plant Composition (R2-2200-OP) sampling method. Enter the plot radius (for circular plots) or length (for rectangular plots) to the nearest foot. The length of the cover-frequency and/or line intercept transect is recorded on the respective forms for those methods. Different sized plots may be used for sampling live versus dead trees. Use field 35a for the live tree plot and field 35b for the dead tree plot.

Required.
Accuracy Standards = ± 1 foot.

FIELD 36: PLOT WIDTH (3-NUM)

If a rectangular plot is used for the describing the General Field Data or for the ocular plant composition plot, then enter the width of the plot to the nearest foot in this field. If a circular plot shape is used, enter "000" (numeric). This describes the plot size used in completing the General Field Data Form (R2-2200-GF) and Plant Composition Form (R2-2200-OP) sampling methods. The width of the cover-frequency and/or line intercept transect is an inherent part of the design of these sampling methods and is not recorded here. Different sized plots may be used for sampling live versus dead trees. Use field 36a for the live tree plot and field 36b for the dead tree plot.

Required.
Accuracy Standards = ± 1 foot.

FIELD 37: PLOT REMEASUREMENT INTERVAL (2-NUM)

For permanent plots, enter the number of years to the next measurement. For example, "00" indicates that the plot is not a permanent plot; "01" means remeasure annually; "02" means remeasure 2 years from now; "15" means it will be measured 15 years from now, and "-1" means the interval is unknown.

Required, for permanent plots.
Accuracy Standards = No Errors.

FIELD 38: PERMANENT PLOT KEY ID (15-CHAR)

Duplicate the Key ID from fields 1-7 if this plot is to be a permanent plot. However, if this plot is a repeat measurement of a previously established permanent plot, enter the Key ID of the plot corresponding to the first time it was sampled.

Required, for permanent plots.
Accuracy Standards = No Errors.

FIELD 39: COMPARISON PLOT ID (15-CHAR)

Enter the appropriate Key ID for a plot to be used as a comparison with this plot when doing paired plot sampling. When two plots are strategically located so as to provide an intentional comparison, the Key ID (or record identifier) for the second plot would be coded in this field. Likewise, the Key ID for the second plot would be coded on the R2-2200-GF Form for the first plot.

For example, two plots placed on either side of a fence may be linked through this field for comparison purposes. Another example is two plots placed in close proximity to each other, where both plots represent independent samples yet describe very similar conditions. The purpose of completing this field is that it is of importance during analysis of the data.

Required, if paired plot sampling is employed.
Accuracy Standards = No Errors.

LOCATION

Fields 40-78 are related to various ways of describing the plot location. Not all are required. However, describing the plot location in some fashion is required.

FIELD 40: QUAD IDENTIFICATION (10-CHAR)

Enter the Forest Service or USGS code for the quad sheet used in locating the plot. The first character of this code is "F" (Forest Service) or "G" (USGS). Enter "X" if this information is not available. The 9-character quad identification is composed of the latitude and longitude of the southeast corner of the quad. This is the officially prescribed format for the Rocky Mountain Region. The number is written with latitude degrees and minutes followed by longitude degrees and minutes. For example, the Boggy Draw quad (37° 30' latitude and 108° 30' longitude) would be:

F373010830

Optional.
Accuracy Standards = No Errors.

FIELD 41: QUAD SERIES (4-NUM)

Enter the series of the quad sheet, either "07.5" or 15.0".

Optional.
Accuracy Standards = No Errors.

FIELD 42: QUAD NAME (20-CHAR)

Enter the quad sheet name. Use the standardized list of quad names. This is more of a reference for the examiner than anything else. A cross-reference table relating the quad identifier to the name will exist in the district production data base.

Optional.
Accuracy Standards = No Errors.

Traditionally plot locations have been to the nearest quarter-quarter section with a pin-pricked photo or ink dot on a map to specify the exact location. With the advent of GPS and GIS technologies there are two other avenues of specifying a plot location that are becoming increasingly more common. The required minimum is that one or the other must be provided, while the traditional legal location is just an option. Identifying the plot location by either latitude/longitude or UTM coordinates is the required approach.

FIELDS 43-46: LATITUDE (8-NUM)

Enter the degrees, minutes, seconds, and hundredths of a second for the latitude coordinate of the plot. It is assumed that the latitude is north of the equator. An example entry is:

N 45° 16' 12.25"

Required, if UTM coordinates are not recorded.
Accuracy Standards = ± 15 seconds.

FIELDS 47-50: LONGITUDE (9-NUM)

Enter the degrees, minutes, seconds, and hundredths of a second for the longitude coordinate of the plot. It is assumed that the longitude is west of the Greenwich Prime Meridian. An example entry is:

W 106° 26' 22.55"

Required, if UTM coordinates are not recorded.
Accuracy Standards = ± 15 seconds.

FIELDS 50-53: UTM (20-CHAR)

Enter the Universal Transverse Mercator Grid Codes for the coordinates of the plot. Enter the last two digits of the year of the UTM projection used to locate the plot. Most quads have 1927 UTM projection, but some revised quads will have a newer 1983 projection. The 1983 projection is different than the 1927 projection. In order to cross-reference location, projection dates are required. Enter the north UTM coordinate (8-num), the east UTM coordinate (8-num), and the UTM elevation (5-num) for the plot location.

Required, if latitude/longitude coordinates are not recorded.
Accuracy Standards = ± 100 meters.

FIELDS 54-59: LEGAL ID (8-NUM)

Describe the legal location of the plot. Identify the principal meridian code (2-num). Enter the township and range, including the cardinal indicator (5-char). Space has been provided for half-townships or half-ranges -- do not fill these in if they are not needed. Enter the section number (2-num). Enter the quarter section (2-char) and quarter-quarter section (2-char) as necessary; use NE, SE, SW, or NW.

Optional.
Accuracy Standards = No Errors.

WATERSHED

These fields identify the watershed where the plot is located. The codes are hierarchical in that they describe coarse (5th level) to detailed (9th level) watershed delineations. Consult the Forest hydrologist or fisheries biologist for a listing of codes to be used in the survey area.

FIELD 60: 5TH LEVEL (10-NUM)

Enter the appropriate 5th level watershed code.

FIELD 61: 6TH LEVEL (2-NUM)

Enter the appropriate 6th level watershed code.

FIELD 62: 7TH LEVEL (2-NUM)

Enter the appropriate 7th level watershed code.

FIELD 63: 8TH LEVEL (2-NUM)

Enter the appropriate 8th level watershed code.

FIELD 64: 9TH LEVEL (2-NUM)

Enter the appropriate 9th level watershed code.

Optional.
Accuracy Standards = No Errors.

FIELD 65: GPS FILE NAME (8-CHAR)

Enter the name of the GPS file containing the point location. If a GPS unit is not used to determine the coordinates, enter "NA".

Optional.
Accuracy Standards = No Errors.

FIELD 66: PURPOSE (8-CHAR)

Enter one of the following codes to describe the primary purpose for which the data was collected. If more than one code applies, such that no one purpose is primary, enter "I I" to indicate integrated inventory or monitoring. (The first column is a rough grouping to assist the examiner in finding the correct code -- it is not to be coded on the field form!)

	CODE	DESCRIPTION
silviculture	SE	Correlation with stand exam
	PT	Correlation with permanent timber management plot
	RE	Correlation with regeneration exam/stake rows
	FE	Evaluation of fire effects or fire history and fuels
wildlife & range	PS	TES plant species habitat analysis
	AS	TES animal species habitat analysis
	WH	General wildlife habitat
	BG	Big game habitat evaluation
	RA	Range allotment inventory
	RM	Range monitoring (e.g., readiness, trend, utilization)
soil & water; misc	AR	Analysis of recreational impacts -- human or stock
	SS	Correlation with soil survey
	WI	Watershed inventory
	WM	Watershed monitoring
	MR	Mining or oil/gas pad rehabilitation monitoring
	RP	Research plots
	SD	Correlation/verification for spectral data/landsat
ecology	RN	RNA and special interest area analysis
	EC	New ecosystem classification or succession analysis
	I I	Integrated multi-resource inventory/monitoring
	HT	Previous habitat type classification data
	WE	Wilderness ecology inventory or monitoring
other	O	Other purpose not identified (explain on comments form)
	N	Not applicable
	X	Unable to assess

Optional.
Accuracy Standards = No Errors.

FIELD 67: PROJECT (6-CHAR)

Enter a user-specified project code which is unique by ranger district and purpose. A record of project codes should be kept by the designated forest or district data administrator.

Optional.
Accuracy Standards = No Errors.

FIELD 68: FIRST PHOTO (2-NUM)

Enter the exposure number that corresponds to the first photo taken on the plot. This information, and the next, are often priceless when it comes time to sort out several rolls of pictures next winter.

Optional.
Accuracy Standards = No Errors.

AERIAL PHOTO IDENTIFICATION

These fields identify the aerial photo on which the plot can be identified. Most of the information is on the photo.

FIELD 69: DATE (10-CHAR)

Enter the flight date (MM/DD/YY) of the aerial photo used to locate this plot.

Optional.
Accuracy Standards = No Errors.

FIELD 70: SOURCE (5-CHAR)

Optional.
Accuracy Standards = No Errors.

FIELD 71: SCALE (5-CHAR)

Optional.
Accuracy Standards = No Errors.

FIELD 72: PROJECT/CODE (6-CHAR)

Optional.
Accuracy Standards = No Errors.

FIELD 73: FLIGHT LINE (3-CHAR)

Optional.
Accuracy Standards = No Errors.

FIELD 74: ROLL NUMBER (3-CHAR)

Optional.
Accuracy Standards = No Errors.

FIELD 75: EXPOSURE NUMBER (3-CHAR)

Optional.
Accuracy Standards = No Errors.

FIELD 76: STATE (2-CHAR)

Enter the two-character postal abbreviation to identify the state in which the plot is located. The five states in the Rocky Mountain Region are listed below.

Optional.
Accuracy Standards = No Errors.

FIELD 77: COUNTY (3-CHAR)

Enter the three-character code to identify the county in which the plot is located. The counties and their codes are listed below.

Optional.
Accuracy Standards = No Errors.

FIELD 78: ALLOTMENT/PASTURE IDENTIFIER (5-CHAR)

Identify the range allotment and pasture in which the plot is located. Enter "X" if the allotment identifier or the pasture identifier cannot be determined.

Optional.
Accuracy Standards = No Errors.

County Number	COLORADO (CO)	KANSAS (KS)	NEBRASKA (NE)	SOUTH DAKOTA (SD)	WYOMING (WY)
1	Adams	Allen	Adams	Armstrong	Albany
3	Alamosa	Anderson	Antelope	Aurora	Big Horn
5	Arapahoe	Atchison	Arthur	Beadle	Campbell
7	Archuleta	Barber	Banner	Bennett	Carbon
9	Baca	Barton	Blaine	Bon Homme	Converse
11	Bent	Bourbon	Boone	Brookings	Crook
13	Boulder	Brown	Box Butte	Brown	Fremont
15	Chaffee	Butler	Boyd	Brule	Goshen
17	Cheyenne	Chase	Brown	Buffalo	Hot Springs
19	Clear Creek	Chautauqua	Buffalo	Butte	Johnson
21	Conejos	Cherokee	Burt	Campbell	Laramie
23	Costilla	Cheyenne	Butler	Charles Mix	Lincoln
25	Crowley	Clark	Cass	Clark	Natrona
27	Custer	Clay	Cedar	Clay	Niobrara
29	Delta	Cloud	Chase	Codington	Park
31	Denver	Coffey	Cherry	Corson	Platte
33	Dolores	Comanche	Cheyenne	Custer	Sheridan
35	Douglas	Cowley	Clay	Davison	Sublette
37	Eagle	Crawford	Colfax	Day	Sweetwater
39	Elbert	Decatur	Cuming	Deuel	Teton
41	El Paso	Dickinson	Custer	Dewey	Uinta
43	Fremont	Doniphan	Dakota	Douglas	Washakie
45	Garfield	Douglas	Dawes	Edmunds	Weston
47	Gilpin	Edwards	Dawson	Fall River	
49	Grand	Elk	Deuel	Faulk	
51	Gunnison	Ellis	Dixon	Grant	
53	Hinsdale	Ellsworth	Dodge	Gregory	
55	Huerfano	Finney	Douglas	Haakon	
57	Jackson	Ford	Dundy	Hamlin	
59	Jefferson	Franklin	Fillmore	Hand	
61	Kiowa	Geary	Franklin	Hanson	
63	Kit Carson	Gove	Frontier	Harding	
65	Lake	Graham	Furnas	Hughes	
67	La Plata	Grant	Gage	Hutchinson	
69	Larimer	Gray	Garden	Hyde	
71	Las Animas	Greeley	Garfield	Jackson	
73	Lincoln	Greenwood	Gosper	Jerauld	
75	Logan	Hamilton	Grant	Jones	
77	Mesa	Harper	Greeley	Kingsbury	
79	Mineral	Harvey	Hall	Lake	
81	Moffat	Haskell	Hamilton	Lawrence	
83	Montezuma	Hodgeman	Harlan	Lincoln	
85	Montrose	Jackson	Hayes	Lyman	
87	Morgan	Jefferson	Hitchcock	McCook	
89	Otero	Jewell	Holt	McPherson	
91	Ouray	Johnson	Hooker	Marshall	
93	Park	Kearny	Howard	Meade	
95	Phillips	Kingman	Jefferson	Mellette	
97	Pitkin	Kiowa	Johnson	Miner	
99	Prowers	Labette	Kearney	Minnehaha	

County Number	COLORADO (CO)	KANSAS (KS)	NEBRASKA (NE)	SOUTH DAKOTA (SD)	WYOMING (WY)
101	Pueblo	Lane	Keith	Moody	
103	Rio Blanco	Leavenworth	Keya Paha	Pennington	
105	Rio Grande	Lincoln	Kimball	Perkins	
107	Routt	Linn	Knox	Potter	
109	Saguache	Logan	Lancaster	Roberts	
111	San Juan	Lyon	Lincoln	Sanborn	
113	San Miguel	McPherson	Logan	Shannon	
115	Sedgwick	Marion	Loup	Spink	
117	Summit	Marshall	McPherson	Stanley	
119	Teller	Meade	Madison	Sully	
121	Washington	Miami	Merrick	Todd	
123	Weld	Mitchell	Morrill	Tripp	
125	Yuma	Montgomery	Nance	Turner	
127		Morris	Nemaha	Union	
129		Morton	Nuckolls	Walworth	
131		Nemaha	Otoe		
133		Neosho	Pawnee	Washington	
135		Ness	Perkins	Yankton	
137		Norton	Phelps	Ziebach	
139		Osage	Pierce		
141		Osborne	Platte		
143		Ottawa	Polk		
145		Pawnee	Red Willow		
147		Phillips	Richardson		
149		Pottawatomie	Rock		
151		Pratt	Saline		
153		Rawlins	Sarpy		
155		Reno	Saunders		
157		Republic	Scotts Bluff		
159		Rice	Seward		
161		Riley	Sheridan		
163		Rooks	Sherman		
165		Rush	Sioux		
167		Russell	Stanton		
169		Saline	Thayer		
171		Scott	Thomas		
173		Sedgwick	Thurston		
175		Seward	Valley		
177		Shawnee	Washington		
179		Sheridan	Wayne		
181		Sherman	Webster		
183		Smith	Wheeler		
185		Stafford	York		
187		Stanton			
189		Stevens			
191		Sumner			
193		Thomas			
195		Trego			
197		Wabaunsee			
199		Wallace			

County Number	COLORADO (CO)	KANSAS (KS)	NEBRASKA (NE)	SOUTH DAKOTA (SD)	WYOMING (WY)
201		Washington			
203		Wichita			
205		Wilson			
207		Woodson			
209		Wyandotte			

RELATED POLYGONS

List the polygon types, such as CVU, CLU, RMRIS, range sites, and soil map units, that will be linked to this data. If listing the CVU, also record the horizontal component that the point is located in. This is a temporary linkage to the CVU polygon as the polygon boundary can change over time. This information will aid in the transition of existing data such as RMRIS to the district production data base.

Optional.
Accuracy Standards = No Errors.

SITE DATA

This grouping of information (fields 79-104) describes certain environmental, topographic, and biotic attributes. These pieces of information are important for evaluating data for any purpose.

FIELD 79: SPECIAL FEATURE INFORMATION (2-CHAR)

If the dominant environment of the plot is one of the following special features (see page 3-132), enter the appropriate code. In many cases, there is no special feature; enter an "NA" in this case. These codes are hierarchical in design, consequently you may choose from the more generic codes (for example, "AC", "NS", or "SE") or from the more detailed codes (for example, "AN", "SW", or "BE"). (The first column is a rough grouping to assist the examiner in finding the correct code -- it is not to be coded on the field form!)

Required.
Accuracy Standards = Good Judgment.

FIELDS 80-82: LANDFORM (3 2-CHAR)

Enter one of the following codes (see page 3-133) to describe the landform where the plot exists. The codes presented are hierarchical in that they describe general to specific landform settings. The first 2-character field provided (that is, the "tens") is always recorded and represents the landform group. The second 2-character code (the "ones") represents the landform refinement of the group. The third field is reserved at this time, but will eventually be codes for further refinements, based on dissection and/or slope classes.

Required.
Accuracy Standards = Good Judgment.

SPECIAL FEATURES

	CODE		DESCRIPTION
	NA		Not applicable
rocky	AC		Avalanche chute
		AN	With non-scoured surface (soil not being eroded)
		AS	With scoured surface (soil eroded, rocks exposed)
	CR		Scree (sheet of stones or rocky debris mantling a slope)
	TA		Talus (rock fragments derived from and positioned at the base of a cliff)
cave	CV		Cave
crop	CL		Cropland
		CD	Dryland crops
		CI	Irrigated crops
moist	SC		Streamside community
	SB		Stream bar community
	NS		Non-stream riparian communities
		SW	Shrub wetland (for example, willows and birches)
		WM	Wet meadow dominated by graminoids (for example, sedges and grasses)
		PE	Peatland (for example fen, bog, and carr)
		FL	Floating or quaking bog or fen mat
	LA		Lakeside communities
seep	SA		Swale (concave or bench area with no surface water, but moist surface soil produces vegetation reflecting a moist environment)
	SE		Seep and/or spring
		BE	Concave bench with surface water creating moist or wet soil that support vegetation reflecting a moist site
		SS	Side slope seep (not on bench or concavity)
terrace	TE		Terrace (in valley bottom)
affects micro-climate	SN		Snow catchment area (retains snow cover 2-4 weeks longer than 90% of the surrounding areas of same aspect due to deeper snow accumulation on a different physiographic location, includes nivational hollows)
	CA		Cold air drainage and frost pocket
	WB		Wind blasted environments where vegetation is maintained in a deformed state
	UW		Upslope warm air flow; area that is in the direct path of afternoon warm air upslope flow from an adjacent deep valley bottom or a thermal belt above a cold air inversion area
	WU		Windswept upper slopes that do not accumulate snow and are relatively dry due to snow loss in comparison to adjacent areas
ribbon forest	RI		Ribbon forest
		RR	Ridge top ribbon forest
		RS	Snow-caused ribbon forest
		RG	Geologically-caused ribbon forest
	O		Other (explain on Form CD, comments data)
	X		Unable to assess

Coordinate with Regional Office for additional codes.

LANDFORMS

CODE	NAME	DESCRIPTION
10	Mountain Summits	Mountain Summits occupy high elevation (above timberline) summit positions and includes subordinate high elevation shoulders and backslopes. They are formed as part of mountain building processes.
11	Rugged Mountain Summits	This landform consists of a diverse group of high elevation mountain peaks dominated by rock, talus slopes, scree, and minimal amounts of soil. The vegetation that does occur in isolated pockets within this landform consists of mosses, lichens, and a few hardy alpine plants. Streams are few or absent. Horizontal and vertical slope shapes tend to be planar rather than rounded.
12	Rounded Mountain Summits	This landform consists of high elevation mountain summits that are broad and rounded rather than distinct ridge lines. It is less steep than Rugged Mountain Summits. Rock outcrop is common but not as frequent as in Rugged Mountain Summits. Drainage development is weak to absent. The summit positions receive longer duration of solar radiance than the Rugged Mountain Summits.
20	Steep Mountain Slopes	Steep Mountain Slopes normally occupy subordinate elevations, but may be adjacent to the Mountain Summits. They are formed as part of mountain building processes and undergo weathering and erosion by water, ice, and wind. They receive hydrologic inputs directly from snow and rain, and may receive additional indirect inputs of rain and summer snowmelt runoff from the adjacent Mountain Summits.
21	Broken	This landform consists of broken, discontinuous mountain slopes. The brokenness is caused by local topographic features such as knobs and benches. Shoulder, backslope, and footslope components are included in this landform. Drainage dissection is slightly to highly dissected and has a dendritic or complex drainage pattern.
22	Smooth	This landform consists of smooth continuous mountain slopes. Ridges are included where they are too small to map as Rounded Mountain Summits. Shoulder, backslope and footslope components are included in this landform.

LANDFORMS

CODE	NAME	DESCRIPTION
30	Moderate Mountain Slopes	
31	Broken	
32	Smooth	

LANDFORMS

CODE	NAME	DESCRIPTION
40	Hills	Hills consist of one or several hills from 50 to 1000 feet in external relief which have summits below timberline and are not influenced by alpine climates. They are physically separated from Mountains Landforms.
41	Hill Summits	The top or highest level of a hill bounded on all sides by descending hill slopes.
42	Broken	This landform consists of broken, discontinuous hill slopes. The brokenness is caused by local topographic features such as knobs and benches. Shoulder, backslope and footslope components are included in this landform. Ridges are included where they are too small to map as Hill Summits. Drainage dissection is slightly to highly dissected with a dendritic or complex drainage pattern.
43	Smooth	Smooth hill slopes. Ridges are included where they are too small to map as Hill Summits. Shoulder, backslope and footslope components are included in this landform.
44	Badlands	A group of highly dissected hills commonly characterized by short steep slopes and narrow interfluves on soft sedimentary deposits of clay and silt. They are often completely free of vegetation. Dissected areas may be rounded or knife-edged depending on underlying material. Badlands are usually formed in regions of marked seasonal contrasts, usually with a fairly long dry season. The essential cause is lack of vegetation, a condition favored by a strong seasonality with an extended arid period or man-made effects. There are no structural controls or rock outcrops. Denuding is primarily caused by water erosion of soft, highly erodible sedimentary rocks. Badland areas include the Mancos Shale of Western Colorado, White River Group of Wyoming, and Badlands of South Dakota (Brule and Chadron Formation).
45	Rolling Hills	A series of distinctly separate but adjoining hills intermixed with plains or valley floors.
46	Sand Dunes	Sand dunes are mounds, ridges, hills and valleys composed of windblown sand. This landform is limited in extent to areas adjacent to the Great Sand Dunes National Monument. Sand Dunes may be actively shifting or stabilized.

LANDFORMS

CODE	NAME	DESCRIPTION
50	Canyon Lands	
51	Ravines	
52	Gorges	Deeply entrenched third order and larger streams which include valley floors and sidewalls. They have very steep sideslopes. Gorges often contain narrow flood plains in addition to the stream channel.
53	Canyon Slopes	
54	Escarpment	

LANDFORMS

CODE	NAME	DESCRIPTION
60	Lowlands and Plateaus	Lowlands and Plateaus consist of elevated tracts of comparatively flat or level ground that may be dissected by deep valleys. The landforms developed on plateaus are of a lower relief than that of the plateau itself. A plateau may therefore also contain a plain, or the uneroded part of it may contain a plain.
61	Rolling Lowlands	
62	Depressional Lowlands	
63	Plateau and Plain	
64	Kettle Topography	Extensive undulating glacial moraines with low relief and gentle slope gradients. Kames are mounds up to 100 feet in relief. Depressions are filled with ponds and small lakes that may be perennial or intermittent.
70	Footslopes	
71	Footslopes	Footslopes located at the base of mountain slopes or hill slopes. Slope gradients are less than 40 percent.
72	Bajadas	Broad alluvial deposits formed by the lateral coalescence of a series of alluvial fans and interspersed with colluvial footslopes.

LANDFORMS

CODE	NAME	DESCRIPTION
80	Valley Floor	Valley Floors consist of valley bottoms within the other landform groups. They are comprised of singular or coalescing alluvial fans and bajadas, flood plains, terraces, and channels. Slope gradients are generally less than 15 percent. Valley Floors are formed by deposition processes originating from colluvial, fluvial, or glacio-fluvial activity.
81	Floodplains	Nearly level alluvial or glacio-fluvial plains. They occupy valley floors and cirque basin bottoms which are associated with periodic flooding by third order or larger streams. It may include the stream channel depending on the channel width.
82	Alluvial Fans	Alluvial deposits found in a valley floor and dominated by aggrading stream channels at the mouth of a stream. Usually occurs at the base of dissected Mountain Slopes and Hills. Slopes are generally less than 15 percent.
83	Terraces	Abandoned flood plains or flood plains which are rarely inundated. They exist as benches along the valley floor, adjacent to but above the current active flood plain.
84	Cirque Basins	Cirques are semi-circular or elongated hollows resulting from the erosive activity at the head of an alpine glacier. They are characterized by a steep, nearly vertical headwall, a concave floor that slopes gently towards the cirque threshold and a threshold at the entrance which may be bedrock, glacial moraine or both. The threshold may impound a cirque lake (tarn).
90	Landslide Terrain	
91	Slump Block	
92	Earthflow	
OT	Other	
NA	Not Applicable	
XX	Unable to Assess	

FIELDS 83-85: SURFICIAL GEOLOGY (2-CHAR, 2-CHAR, 3-CHAR)

Enter the following codes to describe the parent material (surficial geology). Parent material is the source of soil development. Limit observation of this attribute to the plot itself, in other words, identify the parent material as if a soil pit was dug in the middle of the plot. The parent material can be identified from road cuts, stream channel cuts, or a quick scratch hole. In some cases, the soil resource inventory (SRI) or common land unit (CLU) will identify the parent material. When using SRI or CLU information, be sure that the description matches the site on the ground.

The first field is required and the second field is strongly recommended. The first field is the broad geologic group, such as igneous, sedimentary, metamorphic, etc.

The second group is the member of the group, that is the specific lithologic unit. the lithologic unit is a system of rock classification based on manner of origin, composition, and texture. Lithologic unit represents two hierarchical levels: group (primary) and member (secondary). It is identified from USGS geologic maps and verified on the ground. Examples of the nomenclature and coding for lithologic unit are limestone (Ls-consolidated material) and loess (Uw-unconsolidated material).

The third code is the 2- or 3-character code from the USGS geology map. It is the code that corresponds to the geologic formation for the site, a mappable body of rock identified by distinctive characteristics, some degree of internal homogeneity, and stratiographic position. It identifies both primary and secondary lithology. Examples of the nomenclature and coding for geologic formation are Mancos Shale Formation (Km) and Morrison Formation (Jm).

Required.
Accuracy Standards = No Errors.

GEOLOGY

CODE	GROUP	CODE	LITHOLOGIC MEMBER
IG	IGNEOUS		**Phaneritic texture**
		Sy	Syenite
		Gr	Granite
		Mo	Monzonite (quartz)
		Gd	Granodiorite
		Di	Diorite
		Ga	Gabbro
		Pe	Peridotite
			Pegmatitic texture
		Pg	Pegmatite
			Aphanitic texture
		Tr	Trachyte
		Rh	Rhyolite
		La	Latite
		Da	Dacite
		An	Andesite
		Ba	Basalt
			Glassy texture
		Ob	Obsidian
		Pu	Pumice
		So	Scoria (Porcellanite)
		Tf	Tuff

GEOLOGY

CODE	GROUP	CODE	LITHOLOGIC MEMBER
SE	**SEDIMENTARY**		**Gravel**
		Co	Conglomerate
		Br	Breccia
			Sand
		Ss	Sandstone
		Ar	Arkose
		Gw	Graywacke
			Mud
		Sh	Shale
		Si	Siltstone
		Sk	Carbonate
		Ls	Limestone
		Do	Dolomite
		Tu	Tufa (welded tuff)
		Tv	Travertine
			Silica
		Ch	Chert
		Dt	Diatomite
		Ph	Phosphorite
		He	Hematite
		Ln	Limonite
			Evaporate
		Gy	Gypsum
		Ah	Anhydrite
		Ha	Halite
			Carbonaceous
		Pe	Peat
		Lg	Lignite
		Cb	Coal, Bituminous
		Ca	Coal, Anthracite
		As	Asphalt
		Sx	Interbedded sandstone and shale

GEOLOGY

CODE	GROUP	CODE	LITHOLOGIC MEMBER
ME	METAMORPHIC		**Foliate**
		Gn	Gneiss
		Sc	Schist
		Pl	Phyllite
		Sl	Slate
		My	Mylonite
			Massive
		Ar	Argillite
		Si	Siltite
		Mq	Metaquartzite
		Qu	Quartzite
		Mr	Marble
		Ho	Hornfels
		So	Soapstone
		Sp	Serpentine
		Am	Amphibolite
		Mg	Migmatite
UN	UNCONSOLIDATED	Uf	**Alluvium**
		Ga	Gravelly alluvium
		Aa	Sandy alluvium
		Si	Silty alluvium
		Ca	Clayey alluvium
			Mixed
		Ma	Mixed alluvium
		Ms	Mixed sedimentary
		Mm	Mixed metamorphic
		Mi	Mixed igneous
		Mx	Mixed from more than two rock types
			Other
		Uc	Colluvium
		Ue	Eolian
		Ug	Glacial
		Gt	Glacial till
		Ul	Lacustrine
		Um	Marine
		Uh	Human-caused
		Uo	Organic
		Sa	Sand
		Us	Transitional
		Uw	Loess
		Uv	Volcanic Ash
OT	OTHER		
NA	NOT APPLICABLE		
XX	UNABLE TO ASSESS		

FIELDS 86-87: PLOT POSITION (2 2-CHAR)

Enter up to two of the following codes to describe the position of the plot. These codes describe the plot position within the broader landform or landscape. These descriptors would not be applied to the entire mountain range or watershed. Instead they describe an intermediate level between landform and micro-site. This attribute helps to describe intermediate climatic and physiographic features which may influence the site. The codes are hierarchical in that they allow general (code 1) to specific (code 2) descriptions of plot position.

CODE 1	PLOT POSITION 1	CODE 2	PLOT POSITION 2	CODE 2	PLOT POSITION 2
NV	Narrow Valley Bottom (< 100 ft wide)	SC	Stream channel	CF	Colluvial deposit (fan)
		SB	Stream bar	TE	Terrace
		LE	Levee (narrow flood plain)	OT	Other type
MV	Moderate Valley Bottom (100-300 ft wide)	SC	Stream channel	BS	Backwater slough
		FP	Flood plain	TE	Terrace
		AM	Abandoned meander	AF	Alluvial fan (toeslope)
		OX	Oxbow	OT	Other type
WV	Wide Valley Bottom (> 300 ft wide)	SC	Stream channel	BS	Backwater slough
		SB	Stream bar	TE	Terrace
		FP	Flood plain	AF	Alluvial fan (toeslope)
		AM	Abandoned meander	OT	Other type
		OX	Oxbow		
AF	Alluvial Fan	LS	Lower slope (fan skirt)	US	Upper slope
		MS	Mid slope		
MS	Mountain Slopes	LS	Lower slope	US	Upper slope
		MS	Mid slope	SS	Short slope, neither upper nor lower (< 100 ft)
BE	Benches	NW	Narrow (< 100 ft wide)	WI	Wide (> 100 ft wide)
SH	Shoulders	NW	Narrow (< 100 ft wide)	WI	Wide (> 100 ft wide)
RI	Ridges	NW	Narrow (< 100 ft wide)	WI	Wide (> 100 ft wide)
RU	Rolling Uplands	FL	Level to rolling plains	US	Upland swell
		UR	Upland ridge	UK	Upland knoll
BK	Badland Breaks	UB	Upland breaks	PL	Plateau, mesa tops
		RB	River breaks	TS	Toeslopes, alluvial/colluvial fans
OT	Other (Explain on Form CD)				
NA	Not Applicable				
XX	Unable to Assess				

Required.
Accuracy Standards = Good Judgment.

PLOT SHAPE

The micro-site shape of a plot, whether it is 0.01, 0.10, or 0.20 acres in size, often influences the relationship between environmental, topographic, and vegetative features. The next two fields (88-89) describe the plot shape along two axes. These axes are referenced various ways in the literature. Here they are called vertical and horizontal. The vertical axis lies perpendicular to the contours; it goes from up-slope to down-slope, regardless of the slope angle. The horizontal axis is oriented across the slope, or with the contour; it goes from side-slope to side-slope. Use the following codes to describe both vertical and horizontal plot shape. The codes are from SCS standard definitions.

CODE	DESCRIPTION
1	Convex, or rounded
2	Planar (straight or even)
3	Concave, or depression
4	Undulating pattern of one or more low relief ridges or knolls and draws within plot area
5	Complex -- patterned (for example, micro-relief of hummock and swales with several feet)
O	Other (explain on Form CD)
N	Not applicable
X	Unable to assess

FIELD 88: VERTICAL PLOT SHAPE (1-CHAR)

Enter one of the above codes that best describes the vertical shape of the micro-site where the plot is located. It is generally confined to the dimensions of a 0.10 to 0.20 acre plot.

Required.
Accuracy Standards = No Errors.

FIELD 89: HORIZONTAL PLOT SHAPE (1-CHAR)

Enter one of the above codes that best describes the horizontal shape of the micro-site where the plot is located. It is generally confined to the dimensions of a 0.10 to 0.20 acre plot.

Required.
Accuracy Standards = No Errors.

FIELD 90: ELEVATION (5-NUM)

Enter the elevation of the plot above mean sea level (MSL) in feet. Use an altimeter -- be sure to reset the altimeter at a point of known elevation every morning and afternoon. A topographic map may be used to estimate elevation, however be sure to use aerial photos to accurately locate the plot position before making an estimation.

Required.
Accuracy Standards = ± 100 ft.

FIELD 91: COMPASS DECLINATION (3-NUM)

Enter the declination setting for your compass. Do not enter the declination from the map. This field is necessary to accurately analyze data collected from non-declinated, declinated, and incorrectly declinated compasses.

Required.
Accuracy Standards = ± 1 degree.

FIELD 92: ASPECT (3-NUM)

Enter the declination-corrected azimuth of the slope aspect to the nearest degree. Enter flat areas as "0" and North as "360".

Required.
Accuracy Standards = ± 5 degrees.

FIELD 93: SLOPE PERCENT (3-NUM)

Enter the average percent slope of the terrain on which the sample plot is located.

Required.
Accuracy Standards = ± 5 percent.

FIELD 94: EROSION STATUS (2-CHAR)

Enter the most appropriate code describing soil erosion status based on indicators of soil cover, sheet erosion, rill erosion, bank stability. gullying, *etc.* Instability includes situations where human activity has increased the rates of disturbance above that which would occur naturally.

CODE	DESCRIPTION
ST	Soil surface stable and no evidence of accelerated erosion
X	Unable to assess because examiner cannot determine stability or instability compared to undisturbed conditions
UC	Soil surface is unstable because of compaction (weight per unit volume is greater than natural)
UD	Soil surface is unstable because of displacement and/or churning of the soil
UE	Soil surface is unstable due to evidence of accelerated erosion

Required.
Accuracy Standards = Good Judgment.

FIELD 95: EROSION TYPE (2-CHAR)

Enter one of the following codes to describe the dominant erosion process present on the plot.

CODE	DESCRIPTION
NA	Not applicable
SE	Sheet erosion
RE	Rill erosion
GE	Gully erosion
DE	Deposition
WE	Wind erosion
SC	Soil creep
SL	Slump
TD	Terrace development
SD	Slide
SP	Splash erosion/soil crust
OT	Other (explain on Form CD)
XX	Unable to assess

Required.
Accuracy Standards = Good Judgment.

HORIZON SLOPES

Enter the percent slope to horizon from plot center. Negative slopes are entered as zero. These values are used in models to predict, or index, the maximum amount of solar radiation a site may receive. This information is important in describing evapotranspiration and solar energy flux characteristics of the site. These attributes can be quickly collected by taking three additional readings with a clinometer or Relaskop at the same time as slope.

> *NOTE: Horizon is calculated as the percent slope between the plot center and the first landform feature encountered (for example, hill top or ridge line). Vegetation obstruction is ignored in this calculation.*

FIELD 96: HORIZON TO THE EAST (3-NUM)

Enter the percent slope of the vertical angle between the plot center and the horizon to the east of plot center.

FIELD 97: HORIZON TO THE SOUTH (3-NUM)

Enter the percent slope of the vertical angle between the plot center and the horizon to the south of plot center.

FIELD 98: HORIZON TO THE WEST (3-NUM)

Enter the percent slope of the vertical angle between the plot center and the horizon to the west of plot center.

Optional.
Accuracy Standards = ± 5 percent slope.

FIELD 99: FUEL MODEL (2-NUM)

Fuel loading classes are from the fire behavior fuel models of Anderson (1982) and Albini (1976). Enter the appropriate code from the following list. Classes are general and describe the fuels that will drive the fire behavior models. The list has been subdivided into broad groupings to assist the examiner in identifying the correct fuel model. If you are not familiar with this system be sure to reference Anderson (1982) and obtain assistance from a qualified fire behavior specialist. If you do not have Anderson's (1982) publication or have not been trained to identify fuel loading classes, enter "00" in this field. (The first column is a rough grouping to assist the examiner in finding the correct code -- it is not to be coded on the field form!)

Optional.
Accuracy Standards = Good Judgment.

FUEL MODELS

	CODE	DESCRIPTION
	00	Unable to assess.
herb	01	Fine, porous and continuous herbaceous fuels of grasslands, savannas, grass-tundra, and grass-shrub types.
	02	Fine herbaceous fuels with some litter and dead stemwood in habitat types with open shrub and forest overstories.
	03	Tall, thick graminoid-dominated stands.
shrub or woodland	04	Forest or shrub stands with a continuous overstory that contains much flammable wood material.
	05	Forest or shrub stands with light surface fuels and slightly flammable shrub and woody fuels.
	06	Open forest with shrubs or shrubs that have moderate amounts of flammable woody material.
forest	07	Closed forest stands and understory shrub layer with flammable materials in both layers.
	08	Closed conifer stands with low flammability and a compact litter layer.
	09	Closed stands of ponderosa pine with a thick litter layer.
	10	Closed forest types with heavy fuel loading of down woody material.
slash	11	Light logging slash, varying in continuity.
	12	Moderate, continuous logging slash.
	13	Heavy, continuous logging slash.

FIELD 100: AVERAGE FUEL DEPTH (3-NUM)

Determine the average depth of all live and dead ground fuels on the plot to the nearest 0.1 foot. Fuel depth is the vertical distance from the bottom of the litter layer to the highest fuel particle (less than 6.5 feet tall) that is capable of carrying a ground fire under moderate fuel moisture and wind conditions. This value is averaged over the plot (for example, envision a sheet draped over the ground fuels and live and dead shrub/herb layer on the plot and determine the average height of that sheet). This calculation does not include the crowns of overstory trees or any species greater than 6.5 feet tall.

Optional.
Accuracy Standards = ± .5 feet.

FIELD 101: DUFF PLUS LITTER DEPTH (3-NUM)

Determine the average depth of the duff-plus-litter layer on the plot to the nearest 0.10 inch. Duff is the fermentation and humus sections of the organic layer. Litter includes freshly cast organic material (for example, leaves, needles, twigs, bark, and fruits).

Optional.
Accuracy Standards = ± .5 in.

FIELD 102 DEAD WOODY MATERIAL COVER (2-NUM)

Enter the average percent ground cover of dead woody material greater than 3 inches diameter at the large end occurring below 6.5 feet. Include sound and rotten material still distinguishable as a log. The percent of ground covered is estimated by imagining all material lying on the ground and recording the percent of the plot area that would be covered by this material.

Optional.
Accuracy Standards = ± .5 percent.

FIELD 103: DOWN LOG AVERAGE DIAMETER (3-NUM)

Enter an estimate of the average diameter of the down wood material identified in field 102. Entries are to the nearest inch.

Optional.
Accuracy Standards = ± 1 in.

GROUND COVER

Enter percent ground cover at the soil surface plane for each category listed. The percent ground cover can be obtained from an inventory sample, for example ocular plant composition plot or cover-frequency transect. If the ground cover estimates are obtained in this fashion, then enter the percent ground cover value directly from that form. If no inventory sample has been done, then estimate the percent ground cover for each category. Ocularly estimate the percent ground cover, or use the cover classes below and enter the appropriate midpoint value.

CODE	RANGE	MIDPOINT
T	0 - 1.0% cover	0.5%
1	1.1 - 5.0% cover	2.0%
2	5.1 - 25.0% cover	15.0%
3	25.1 - 50.0% cover	37.5%
4	50.1 - 75.0% cover	62.5%
5	75.1 - 95.0% cover	85.0%
6	95.1 - 100.0% cover	97.5%

The total ground cover for all categories will add to 100 percent. Given the range of variability in examiners and the difficulty of summing midpoints, the actual total should be between 90-110 percent. (Foliar canopy cover above the soil surface plane is not considered to be ground cover.)

FIELD 104: WOOD

Charred and uncharred dead wood greater than 0.25 inches (6 mm) in diameter.

FIELD 105: LITTER/DUFF/ ASH

Litter is material less than 0.25 inches (6 mm) in diameter -- freshly fallen leaves, needles, twigs, fecal material, bark, and fruits. Duff is fermentation and humus sections of the organic layer. Ash is charred litter, duff, and scat.

FIELD 106: MOSS/LICHEN/ FUNGUS/ALGA

Moss, lichen, fungus, and alga directly covering the soil surface. Do not include moss or lichen on rock, wood, or other surface. These values are used to characterize the soil surface and the role they play in erosion protection. Examiners are encouraged to record any of these items on the ocular plant composition plot or cover-frequency transect and to assign a percent canopy cover for each. Other studies outside of rangeland inventory and analysis, in particular air quality studies, deal with these life forms at the species level.

FIELD 107: BASAL VEGETATION

The soil surface taken up by the live basal or root crown portion of **vascular** plants. This includes live trees, *Lycopodium*, and *Selaginella*. This is not the **foliar** cover of plants. Typical **basal** plant cover ranges between 10-20 percent; 30 percent is a very high value and is rarely encountered.

FIELD 108: WATER

That portion of the plot area which is covered by standing water at the time of the sampling.

FIELD 109: BARE SOIL

Exposed mineral soil (bare ground) with particle size of less than 0.0625 inches (2 mm) diameter soil particles.

FIELD 110: GRAVEL

Exposed mineral material with particle size between 0.0625-3.0 inches (2-78 mm) in diameter.

FIELD 111: COBBLE

Exposed mineral material with particle size between 3.0-10.0 inches (78-254 mm) in diameter.

FIELD 112: STONE

Exposed mineral material with particle size between 10.0-24.0 inches (254-610 mm) in diameter.

FIELD 113: BOULDER

Exposed mineral material with particle size greater than 24.0 inches (610 mm) in diameter.

FIELD 114: BEDROCK

Exposed bedrock material.

Required.
Accuracy Standards = ± 1 class.

MAJOR EVENTS
FIELDS 115-126

Describe major or disturbance events. Each event must be described by type, date (estimated as accurately as possible), intensity, and estimated periodicity of the event type prior to the last occurrence.

EVENT TYPE (4-CHAR)

Enter one of the following codes to describe the event type. The types are identified by a broad category and then subdivided by more specific event descriptions. Identifying the broad category is required. Identifying the more specific type is optional, but should be done if the specific type can be identified.

Required.
Accuracy Standards = Good Judgment.

BROAD CATEGORY	SPECIFIC TYPE	DESCRIPTION
BU		**burn scenarios (fire)**
	BB	broadcast slash burn -- planned ignition
	WS	wildfire in slash
	JB	jackpot burn
	DP	dozer pile and burn
	UB	understory burn
	WN	wildfire -- natural fuels
	PI	prescribed burn -- planned ignition in natural fuels
	UI	prescribed burn -- unplanned ignition in natural fuels
	OB	other burning
DI		**disease attacks**
	BR	butt rot
	BL	blister rust
	GR	gall rust
	HR	heart rot
	NC	needle cast
	RR	root rot
	OD	other disease
GR		**grazing systems**
	SL	season long grazing system
	DR	deferred rotation grazing system
	RR	rest rotation grazing system
	DG	deferred grazing system
	HM	holistic management grazing system
	OC	other cattle grazing system
	OS	other domestic sheep grazing system
HM		**harvest methods**
	CC	clearcut
	FW	firewood harvest
	GS	group selection cut
	HE	heavy equipment disturbance not assoicated with one of the coded activies
	IS	individual selction cut
	OR	overstory removal
	PP	post and pole harvest
	SK	skid trail
	SN	sanitation cut
	ST	seed tree
	SV	salvage cut
	SW	shelterwood
	OH	other timber harvest
IN		**insect infestations**
	AP	aphids
	MP	mountain pine beetle
	SP	spruce budworm
	WE	weevil
	OI	other insect infestation

BROAD CATEGORY	SPECIFIC TYPE	DESCRIPTION
MI		**mining activites**
	TI	tailing impoundment
	WD	waste dump
	OP	open pit or cut
	RR	reclamation by recontouring
	RF	reclamation be fertilization
	RS	reclamation be seeding
	TA	reclamation be topsoil application
	GS	reclamation be ground surface scarification
	OM	other mining activity
RE		**recreation activities**
	FI	fishing
	HI	hiking trails
	CA	camping
	PI	picnicing
	OR	other recreation activity
RG		**regeneration activities**
	BR	bareroot planting
	CS	containerized stock planting
	FA	fertilizer application
	FE	fencing
	GS	grass seeding
	HA	herbicide application
	PA	pesticide application
	PB	poison baiting
	SC	scarification
	SH	shade cards
	SP	scalping
	OG	other regeneration activity
TS		**timber stand improvements**
	CT	commercial thinning
	PC	precommercial thinning
	PR	pruning
	WS	weed species removal
WC		**weather conditions**
	BD	blow down
	DR	drought damage
	FD	frost damage
	FL	flood damage
	IC	ice
	SC	soil creep
	SN	snow
	SS	sun scald
	WD	winter descication

BROAD CATEGORY	SPECIFIC TYPE	DESCRIPTION
WL		**wildlife activities**
	AR	antler rubs
	BR	browsing
	BU	burrows
	DE	denning
	NE	nesting
	RO	rodents
	AN	antelope
	BB	black bear
	BE	bear (species unknown)
	BS	bighorn sheep
	BV	beaver
	CA	cattle
	CO	coyote
	DE	deer
	DO	dog
	DS	domestic sheep
	EL	elk
	GB	grizzly bear
	GS	ground squirrel
	HO	horse
	MG	mountain goat
	ML	mountain lion
	MO	moose
	PD	prairie dog
	PG	pocket gopher
	PM	pine marten
	PQ	porcupine
	PW	pileated woodpecker
	RA	rabbit
	RT	raptor
	TS	tree squirrel
	UB	upland birds
	WO	wolf
	OW	other wildife activity
NA		**not applicable**
OT		**other event type**

DATE OF EVENT (8-NUM)

Estimate the year, month, or date of the most recent occurrence of each event type identified. The time frame specified will depend on the time scale involved with that particular event. Wildfires may be dated to the nearest year, or sometimes nearest decade, depending on how far back the most recent event occurred. Frost damage or sunscald, however, can often be pinpointed to a week, or even a day. Use MM-DD-YYYY format.

Optional.
Accuracy Standards = Good Judgment.

EVENT INTENSITY (1-CHAR)

Describe the intensity of the event in broad general terms. The examiner will normally be familiar with the range of intensities that can occur for any given event type. Grossly estimate the intensity of the most recent event occurrence, using the following codes.

CODE	DESCRIPTION
H	highly disturbed
M	moderately disturbed
S	slightly disturbed
N	no disturbance for 75-100 years
X	unable to assess

Optional.
Accuracy Standards = Good Judgment.

EVENT PERIODICITY (4-NUM, 1-CHAR)

Estimate the return interval for the event identified. This estimate should normally be for the period prior to the last occurrence of the type. This is particularly true for wildfire, where the periodicity may be significantly different before European settlement. The estimate should be reasonable, given the time perspective involved. Decades for wildfire or insect infestations is normal, whereas years for some timber harvest activities or months for grazing systems may be more appropriate. Enter the appropriate numeric value, followed by a "D" (day), "M" (month), or "Y" (year) to indicate the time scale.

Optional.
Accuracy Standards = Good Judgment.

FIELDS 127-132: ANIMAL USE EVIDENCE (6 2-CHAR)

Enter one or more of the following codes to describe animal use evidence in decreasing order of use and effect on vegetation and site characteristics. Evidence may include tracks, browse, caches, beds, wallows, scat, antler rubs, nests or dens, or others.

CODE	DESCRIPTION	CODE	DESCRIPTION
NO	No evidence found		
AN	Antelope	HU	Human
BB	Black bear	MG	Mountain goat
BE	Bear (species unknown)	ML	Mountain lion
BS	Bighorn sheep	MO	Moose
BV	Beaver	PD	Prairie dog
CA	Cattle	PG	Pocket gopher
CO	Coyote	PM	Pine marten
DE	Deer	PQ	Porcupine
DO	Dog	PW	Pileated woodpecker
DS	Domestic Sheep	RA	Rabbit
EL	Elk	RT	Raptor
GB	Grizzly bear	TS	Tree squirrel
GS	Ground squirrel	UB	Upland birds
HO	Horse	WO	Wolf
X	Unable to assess	OT	Other (explain on Form CD)

Consult the Regional Office for additional codes.

Required.
Accuracy Standards = Good Judgment.

EXISTING VEGETATION

The data in this grouping provides information on the existing vegetation, that is the vegetation currently occupying a site. All fields are required. This data grouping represents the best example of information that can be used to stratify a large data set for virtually any purpose, including forest plan revision, area analysis, project planning, biodiversity assessment, and ecological type classification. The absence of this information significantly weakens the utility of the sample outside the sole purpose for which it was established. Therefore these fields are required.

Estimate the percent canopy cover for the following life forms and age/size classes within the shrub and tree life forms. These fields are required. The estimate is the horizontal percent cover of the vertical projection of the particular life form. Ocularly estimate (preferred) the percent canopy cover, or use the cover classes below and enter the appropriate midpoint value.

CODE	RANGE	MIDPOINT
T	0 - 1.0% cover	0.5%
1	1.1 - 5.0% cover	2.0%
2	5.1 - 25.0% cover	15.0%
3	25.1 - 50.0% cover	37.5%
4	50.1 - 75.0% cover	62.5%
5	75.1 - 95.0% cover	85.0%
6	95.1 - 100.0% cover	97.5%

TREE COVER

Estimate percent canopy cover for trees by size class. The size class correspond to those used in the RMRIS data base. These fields are required. This estimate is the horizontal percent cover of the vertical projection of trees; do not account for overlap. Do not include trees less than 6 inches tall. The percent canopy cover can be obtained from an inventory sample, for example ocular plant composition plot. If the canopy cover estimates are obtained in this fashion, then derive the percent canopy cover value from that form. If no inventory sample has been done, then estimate the percent canopy cover for each size class.

FIELD 133: TOTAL TREE COVER (3-NUM)

Total tree cover (do not overlap).

FIELD 134: SEEDLING (3-NUM)

Seedling size cover (≥ 6 inches tall and < 0.1 inch DBH).

FIELD 135: SAPLING (3-NUM)

Sapling size cover (0.1 - 4.9 inch DBH).

FIELD 136: POLE (3-NUM)

Pole size cover (5.0 - 8.9 inch DBH).

FIELD 137: MEDIUM (3-NUM)

Medium size cover (9.0 - 15.9 inch DBH).

FIELD 138: LARGE (3-NUM)

Large size cover (16.0 - 32.9 inch DBH).

FIELD 139: VERY LARGE (3-NUM)

Very large size cover (≥ 33.0 inch DBH)

SHRUB COVER

Estimate percent canopy cover for shrubs by size class. These fields are required. This estimate is the horizontal percent cover of the vertical projection of shrubs; do not account for overlap. The percent canopy cover can be obtained from an inventory sample, for example ocular plant composition plot, cover-frequency transect, or line intercept. If the canopy cover estimates are obtained in this fashion, then derive the percent canopy cover value from the appropriate form. If no inventory sample has been done, then estimate the percent canopy cover for each size class.

FIELD 140: TOTAL SHRUB COVER (3-NUM)

Total shrub cover.

FIELD 141: LOW (3-NUM)

Low size shrub cover (< 2.5 feet tall).

FIELD 142: MIDDLE (3-NUM)

Middle size shrub cover (2.5 - 6.5 feet tall).

FIELD 143: TALL (3-NUM)

Tall size shrub cover (> 6.5 feet tall).

HERBACEOUS COVER

Estimate percent canopy cover for each of the following herbaceous components. These fields are required. These estimates do not count species overlap within a herbaceous component. The percent canopy cover can be obtained from an inventory sample, for example ocular plant composition plot or cover-frequency transect. If the canopy cover estimates are obtained in this fashion, then derive the percent canopy cover value from the appropriate form. If no inventory sample has been done, then estimate the percent canopy cover for each component.

FIELD 144: GRAMINOID (3-NUM)

Graminoid cover.

FIELD 145: FORB (3-NUM)

Forb cover.

FIELD 146: FERN (3-NUM)

Fern and allies cover, including *Lycopodium* spp. and *Selaginella* spp. at ≤ 6.5 feet.

FIELD 147: MOSS & LICHEN (3-NUM)

Moss, lichen, fungi, and other bryophytes.

Required.
Accuracy Standards* = ± *10 percent.

FIELD 148: DOMINANT LIVE LIFE FORM (1-CHAR)

Enter one of the following codes to describe the dominant live life form present on the plot. *Dominant life form* is the life form with the greatest canopy volume, that is:

height *x* cover.

A shrub has a relatively low growth habit, and generally several basal shoots instead of a single bole. It differs from a tree by its low stature and non arborescent form. Use this to differentiate between trees and shrubs for species such as Gambel oak. Use your best judgment. An error here, in the case of the shrub form of Gambel oak versus the tree form is not significant. For most other species, it will be significant. (The first column is a rough grouping to assist the examiner in finding the correct code -- it is not to be coded on the field form!)

Required.
Accuracy Standards = No Errors.

	CODE	DESCRIPTION
forest	C	Conifers dominate
	B	Broadleaf trees dominate
shrub	S	Shrubs dominate
herb	H	Herbaceous species dominate (graminoid/forb/fern mixture)
crop	P	Agricultural cropland
other	A	Aquatic species dominate
	K	Krumholz
	M	Moss or lichens dominate
	N	Non-vegetated soil
	R	Rock or scree
	O	Other (explain on Form CD, Comments Data)
	X	Unable to assess

FIELD 149: LIVE LIFE FORM SIZE CLASS (2-CHAR)

If the dominant live life form (field 43) is tree or shrub, then enter the size class of the dominant layer within that life form from the tables below, that is the size class with the maximum canopy volume. For other life form types, enter "NA" (not applicable). If you are unable to make this assessment, enter an "X" in this field. (The first column is a rough grouping to assist the examiner in finding the correct code -- it is not to be coded on the field form!)

Required.
Accuracy Standards = No Errors.

	CODE	DESCRIPTION
tree (coniferous or deciduous)	VL	Very large tree (> 33.0 in DBH) dominated
	LA	Large tree (16.0 - 32.9 in DBH) dominated
	ME	Medium tree (9.0 - 15.9 in DBH) dominated
	PT	Pole tree (5.0 - 8.9 in DBH) dominated
	SA	Sapling (1.0 - 4.9 in DBH) dominated
	SE	Seedling (< 1.0 in DBH) dominated
shrub	TS	Tall (> 6.5 ft average height) dominated
	MS	Medium (2.5 - 6.5 ft average height) dominated
	LS	Low (< 2.5 ft average height) dominated

FIELD 150: DEAD LIFE FORM SIZE CLASS (2-CHAR)

If the dominant dead life form is tree or shrub, then enter the size class of the dominant layer within that life form from the tables above, that is the size class with the maximum canopy volume. For other life form types, enter "NA" (not applicable). If you are unable to make this assessment, enter an "X" in this field. Use the same table as for field 149.

Required.
Accuracy Standards = No Errors.

FIELD 151: LIVE CANOPY COVER CLASS (1-CHAR)

Enter one of the following codes to quantify the canopy cover of the dominant live life form (field 43). (These codes are different from those used by EcoData in the Northern Region. It is easier for examiners to calibrate their eye with one class coding systems, instead of two.) In this case, enter the one-character code; in most other cases you will be asked to enter the midpoint value.

CODE	RANGE	MIDPOINT
T	0 - 1.0% cover	0.5%
1	1.1 - 5.0% cover	2.0%
2	5.1 - 25.0% cover	15.0%
3	25.1 - 50.0% cover	37.5%
4	50.1 - 75.0% cover	62.5%
5	75.1 - 95.0% cover	85.0%
6	95.1 - 100.0% cover	97.5%

Required.
Accuracy Standards = Within Class.

FIELD 152: AVERAGE HEIGHT OF THE DOMINANT LAYER (3-NUM)

Enter the average height to the nearest foot of the dominant vegetation layer on the plot, that is, the one having the greatest canopy volume.

Required.
Accuracy Standards = ± 10 feet.

Fields 153-158 are used to describe characteristics of the upper (above 6.5 feet), middle (2.5 - 6.5 feet), and lower (below 2.5 feet) vegetation layers. A minimum of 5 percent canopy cover must be present within a layer to distinguish it. Dominant and co-dominant species must each have at least 5 percent canopy cover within a layer to distinguish them. If no individual species within a layer has at least 5 percent cover (yet the layer as a whole has at least 5 percent cover), enter the appropriate code to describe the dominant life form within that layer (for example, "TREE", "SHRUB", "GRASS", and "FORB"). If a layer has no vegetation, enter "NP" to indicate not present.

> *NOTE: Whenever a plant species code (or symbol) is required, use the 8-character alpha-numeric codes from the standard Soil Conservation Service's PLANTS data base. Lists of all species by state are available from the Forest botanist, ecologist, or soil scientist.*

FIELD 153: UPPER LAYER DOMINANT SPECIES (8-CHAR)

Enter the 8-character alpha-numeric species code which identifies the dominant species in the upper layer (above 6.5 feet tall). If no upper layer exists, enter "NP". If you are unable to make this assessment, enter "X".

Required.
Accuracy Standards = No Errors.

FIELD 154: UPPER LAYER CO-DOMINANT SPECIES (8-CHAR)

Enter the 8-character alpha-numeric species code which identifies the co-dominant species in the upper layer (above 6.5 feet tall). If no upper layer exists or exists without a co-dominant species, enter "NP". If you are unable to make this assessment, enter "X".

Required.
Accuracy Standards = No Errors.

FIELD 155: MIDDLE LAYER DOMINANT SPECIES (8-CHAR)

Enter the 8-character alpha-numeric species code which identifies the dominant species in the middle layer (2.5 - 6.5 feet tall). If no middle layer exists, enter "NP". If you are unable to make this assessment, enter "X".

Required.
Accuracy Standards = No Errors.

FIELD 156: MIDDLE LAYER CO-DOMINANT SPECIES (8-CHAR)

Enter the 8-character alpha-numeric species code which identifies the co-dominant species in the middle layer (2.5 - 6.5 feet tall). If no middle layer exists or exists without a co-dominant species, enter "NP". If you are unable to make this assessment, enter "X".

Required.
Accuracy Standards = No Errors.

FIELD 157: LOWER LAYER DOMINANT SPECIES (8-CHAR)

Enter the 8-character alpha-numeric species code which identifies the dominant species in the lower layer (below 2.5 feet tall). If no lower layer exists, enter "NP". If you are unable to make this assessment, enter "X".

Required.
Accuracy Standards = No Errors.

FIELD 158: LOWER LAYER CO-DOMINANT SPECIES (8-CHAR)

Enter the 8-character alpha-numeric species code which identifies the co-dominant species in the lower layer (below 2.5 feet tall). If no lower layer exists or exists without a co-dominant species, enter "NP". If you are unable to make this assessment, enter "X".

Required.
Accuracy Standards = No Errors.

POTENTIAL VEGETATION DATA

The data in this grouping (fields 159-164) provides information on the potential vegetation (plant association, habitat type, or climax plant community). ***Complete the formation field (field 159) for all plots. Complete the remaining fields only if a published potential vegetation classification exists.*** A partial list of classifications is in Appendix E.

FIELD 159: FORMATION (2 CHAR)

Enter one of the following codes to describe the potential vegetation formation of your plot. (The first column is a rough grouping to assist the examiner in finding the correct code -- it is not to be coded on the field form!) Obtain the formation information from the published classification or as the examiner's best professional approximation.

	CODE	DESCRIPTION
forest	CF	Coniferous upland forest
	BF	Broadleaf upland forest
	CW	Coniferous-dominated wetland
	BW	Broadleaf-dominated wetland
shrub	SU	Shrub-dominated upland
	SA	Shrub-dominated alpine
	SW	Shrub-dominated wetland
herb	HU	Herbaceous-dominated upland
	HA	Herbaceous-dominated alpine
	HW	Predominately herbaceous (graminoid, forb, fern) wetland
other	AQ	Aquatic
	ML	Moss/lichen-dominated
	NV	Non-vegetated terrestrial (sand dunes, scree, rock)
	OT	Other type -- specify in comments
	X	Unable to assess

Required.
Accuracy Standards = Good Judgment.

FIELD 160: POTENTIAL NATURAL VEGETATION -- REFERENCE ID (1 4-CHAR AND 1 2-NUM)

This field identifies the publication or reference by which the potential vegetation is classified. The first four characters identify the author(s). The last two characters identify the year of publication. For a single author, use the first four letters of the last name, for example, "COOP75" for the citation:

Cooper, S.V. 1975. Forest habitat types of northwestern Wyoming and contiguous portions of Montana and Idaho, *etc.*

For a reference written by two authors, use the first two letters of each author's last name, in the order they are cited; for example, "MUST80" for the citation:

Mueggler, W.F. and Stewart, W.L. 1980. Grassland and shrubland habitat types of western Montana, *etc.*

For a reference with more than two authors, use the first two letters of the last name of the first author, then the letters O T for "and others"; for example, "PFOT77" for the citation:

Pfister, R.D.; Kovalchik, B.D.; Arno, S.F.; and Presby, R.C. 1977. Forest habitat types of Montana, *etc.*

A partial list of classifications is in Appendix E.

Required, if a classification exists.
Accuracy Standards = No Errors.

> *NOTE: Whenever a plant species code (or symbol) is required, use the 8-character alpha-numeric codes from the standard Soil Conservation Service's PLANTS data base. Lists of all species by state are available from the Forest botanist, ecologist, or soil scientist.*

FIELD 161: INDICATOR SPECIES 1 (8-CHAR)

Enter the 8-character alpha-numeric code of the overstory indicator species which describes the potential vegetation classification of your plot. This is the same as series level classification (for example, ponderosa pine = PIPO). This species may be any life form, dependent on the potential vegetation type. If you are unable to make this assessment, enter an "X" in this field.

Required, if a classification exists.
Accuracy Standards = Good Judgment.

FIELD 162: INDICATOR SPECIES 2 (8-CHAR)

Enter the 8-character alpha-numeric code of the understory indicator species which describes the potential vegetation classification of your plot. This is the same as climax community type, association, or habitat type level classification (for example, fields 161 and 162 = habitat type: ABGR/ASCA). This species may be any life form, dependent on the potential vegetation type. If you are unable to make this assessment, enter an "X" in this field.

Required, if a classification exists.
Accuracy Standards = Good Judgment.

FIELD 163: INDICATOR SPECIES 3 (8-CHAR)

Enter the 8-character alpha-numeric code of an additional understory indicator species which describes the potential vegetation classification of your plot. This is the same as habitat type phase (for example, fields 161, 162, and 163 = habitat type phase: ABGR/ASCA/TABR). This species may be any life form, dependent on the potential vegetation type. If you are unable to make this assessment, enter an "X" in this field.

Required, if a classification exists.
Accuracy Standards = Good Judgment.

FIELD 164: SITE PHASE (8-CHAR)

Enter an alpha-numeric code to describe the primary site phase of the plot. Site phase is rarely identified in potential vegetation classifications. If that is the case, enter an "X" in this field.

Required, if a classification exists.
Accuracy Standards = Good Judgment.

TREE DATA

This data is intentionally sketchy. If complete information regarding the tree portion of a plot is required, then a full stand exam or equivalent will be conducted. The purpose of this data is to give a thumb-nail impression of both live and dead trees. Basal area information can be obtained quickly and easily. Examiners can be trained in approximately five minutes on how to use a prism.

This information is optional, but if collected on forested or woodland sites will aid in coarse level stratification of large data bases. This is especially important at forest and region analyses levels. Collect tree data for both live and dead trees.

FIELDS 165 & 170: BASAL AREA FACTORS (2-NUM)

A different basal area factor (BAF) may be used for live trees and dead trees. In fact, this is encouraged because the density of dead trees is normally significantly less than live trees. Record the BAF used for live and for dead trees, respectively.

Select a BAF that will result in a count, or basal area number (BAN) of 7-10 individuals. Basal area measurements using a prism or Relaskop are designed to most accurate with a BAN within that range. Consequently a BAF of 20 feet^2/acre may be appropriate for live trees, while a BAF of 5 or 10 feet^2/acre may be needed for dead trees.

A BAF of 10 usually works fairly well for open stands on a 0.10 acre plot. A BAF of 20 or 40 works better for denser stands where trees might hide one another. A BAF of 5 works fairly well for sparse park-like stands.

Optional.
Accuracy Standards = No Errors.

FIELDS 166 & 171: BASAL AREA NUMBERS (2-NUM)

Use a variable-factor prism, angle gauge, or Relaskop to count the number of trees that have a width at breast height greater than the projected angle. Record the BAN for live and dead trees, respectively.

Optional.
Accuracy Standards = ± 1 tree count.

BASAL AREA (3-NUM)

Enter the basal area in square feet per acre ($feet^2/ac$), for all trees, live or dead, respectively. Determine the basal area by multiplying the BAF by the BAN. Should there be so few trees that none fall within the variable radius plot, yet the examiner can determine that there are one $feet^2$ or more of basal area represented by the plot, a value less than the BAF is estimated. Enter "0" if no live tree basal area exists.

Optional.
Accuracy Standards = ± 1 tree count times the BAF.

FIELDS 167 & 172: AVERAGE DIAMETER AT BREAST HEIGHT (3-NUM)

Estimate from several measurements and an ocular evaluation the average diameter at breast height of the dominant live tree layer (greatest canopy volume) and the upper dead tree size class layer to the nearest whole inch. The diameter is the average at breast height (4.5 feet above the ground) and includes all live trees greater than 4.5 feet tall.

Optional.
Accuracy Standards = ± 1" for DBH when trees are < 10" and ± 2" for DBH when trees are ≥ 10".

FIELDS 168 & 173: AVERAGE HEIGHT OF DOMINANT LIVE TREE LAYER (3-NUM)

Estimate from several measurements and an ocular evaluation the average height of the dominant live tree layer (greatest canopy volume) and the upper dead tree size class layer to the nearest foot.

Optional.
Accuracy Standards = ± 10 percent

FIELD 169: AVERAGE AGE OF DOMINANT LIVE TREE LAYER (4-NUM)

Enter the average age of the dominant live tree layer (greatest canopy volume). This is best done by counting rings from an increment core of an "average" dominant tree. It can also be done from stump ring counts or knowledge of the area.

Optional.
Accuracy Standards = ± 10 percent

DRY WEIGHT PRODUCTION

Estimate the peak annual dry weight production in pounds per acre (lbs/ac) for each life form. For herbaceous material estimate the current year's leaf growth. For woody species estimate the current year's leaf and leader growth plus the previous year's leader growth. Enter "-1" if production was not assessed. Enter "0" if production was assessed, but a particular life form was not present. Estimating dry weight production is optional; of the six categories, shrub, graminoid, and forb are the most important.

> *These measurements are based, as a minimum, on four subjectively placed plot frames located in representative portions of four quarter sections of the plot. Any size plot frame mentioned in the Inventory Chapter (page 3-96) can be used to estimate production.*

GREEN WEIGHT

Ocularly estimate the green weight by life form in pounds per acre. If you estimate green weight and multiply it by a conversion factor to help estimate dry weight, then estimate green weight in pounds per acre. This value is not entered into the data base for analysis.

Optional.

DRY WEIGHT FACTOR

If you estimate green weight per acre, enter an estimated conversion factor expressed as a decimal. Use dry weight factors (Table 3-9) or data from actual clipping studies to calculate dry weight conversion factors. Conversion values are not entered into the data base for analysis.

Optional.

Tree species production (< 6.5 feet). *Note: Emphasis on "optional".*

FIELD 174: TREE (4-NUM)

Shrub species production (< 6.5 feet).

FIELD 175: SHRUB (4-NUM)

Graminoid species production.

FIELD 176: GRAMINOID (4-NUM)

Forb species production.

FIELD 177: FORB (4-NUM)

Fern and fern allies species production.

FIELD 178: FERN (4-NUM)

Moss, lichen, and other bryophyte species production (< 6.5 feet).

FIELD 179: MOSS (4-NUM)

Optional.
Accuracy Standards = ± 100 lbs/acre.

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GENERAL FIELD DATA (R2-2200-GF)

F1-7: F S -- 0 2 -- 0 4 -- 0 9 -- 9 4 -- M B -- 0 8 2

Key ID | Agency | Region | Forest | District | Year | Exam'r | Plot Number

F8: **BREMERTON, MAXWELL J.**
Name of Examiner (crew leader)

F9: ___
Name of Examiner(s)

F10: ___
Name of Examiner(s)

F11: **08**
Month

F12: **04**
Day

F13: 19
Century

SAMPLE SYSTEM DATA F14-33: CD CF CS GL HU LI OP PD PU RN SD SH UG US VO WS
Sample Forms -- Circle all that apply

LIVE	F34a: E	F35a: 037	F36a: 000	
DEAD	F34b: E	F35b: 053	F36b: 000	F37: 10
	English or Metric Units	Plot Radius / Length (Feet)	Plot Width (Feet)	Plot Remeasurement Interval

F38: **F S -- 0 2 -- 0 4 -- 0 9 -- 8 3 -- D R -- 0 1 7**
Permanent Plot ID

F39: ___-___-___-___-___-___-___
Comparison Plot ID

QUAD SHEET F40: F385210730 (Quad Identification) F41: 07.5 (Quad Series) F42: BOWIE (Quad Name)

LATITUDE (F43-46) N 39 Degrees, 58 Minutes, 05 Seconds, 30 .01 Seconds

LONGITUDE (F47-50) W 107 Degrees, 36 Minutes, 38 Seconds, 10 .01 Seconds

UTM (F48-53) F50: 27 (Year) F51: 43160505 (N) F52: 2748592 (E) F53: 3051 (Z)

LEGAL ID F54: 12S (Township) F55: 91W (Range) F56: 31 (Section) F57: SW (¼ Section) F58: NE (¼ ¼ Section) F59: 6 (PM)

WATERSHED F60: ___ (HUC5) F61: ___ (HUC6) F62: ___ (HUC7) F63: ___ (HUC8) F64: ___ (HUC9)

F65: ___ (GPS File Name) F66: ___ (Purpose) F67 ___ (Project) F68: ___ (Picture Start #)

F69: ___/___/___ (Aerial Photo ID Date) F70: ___ (Source) F71: 1 : ___ (Scale) F76: ___ (State) F77: ___ (County)

F72: ___ (Project/Code) F73: ___ (Flight Line) F74: ___ (Roll #) F75: ___ (Exposure #) F78: ___ (Allotment) ___ (Pasture)

RELATED POLYGONS CVU: CLU: RMRIS: Range Site:

SITE DATA F79: NA (Special Feature) F80-82: ___ | ___ | ___ (Landform) F83-85: SE | Sh | Km (Surficial Geology (Parent Material))

F86-87: MS | US (Plot Position) F88: 2 (Vertical Plot Shape) F89: 1 (Horizontal Plot Shape) F94: ST (Erosion Status)

F90: 9160 (Elevation) F91: 0 (Declination) F92: 010 (Aspect) F93: 15 (Slope) F95: N (Erosion Type)

Horizon Slopes F96: 3 (East Horizon Angle) F97: 5 (South Horizon Angle) F98: 2 (West Horizon Angle)

F99: ___ (Fuel Model) F100: ___.___ (Average Fuel Depth) F101: ___.___ (Duff + Litter Depth) F102: ___ (Dead Wood Cover) F103: ___ (Down Log Diameter)

GENERAL FIELD DATA (R2-2200-GF)

F1-7: FS -- 02 -- 04 -- 09 -- 94 -- MB -- 082

Plot ID	Agency	Region	Forest	District	Year	Exam'r	Plot Number
F1-7	FS	02	04	09	94	MB	082

GROUND COVER

Litter/Duff/Ash	F104: **60**	Bare Soil (< 1/16" diameter)	F109: **20**
Wood	F105: **2**	Gravel (1/16 - 3" diameter)	F110: **5**
Moss/Lichen/Fungus/Alga	F106: **5**	Cobble (3-10" diameter)	F111: **1**
Basal Vegetation	F107: **3**	Stone (10-24" diameter)	F112: **1**
Water	F108: **0**	Boulder (>24" diameter)	F113: **0**
		Bedrock	F114: **0**

MAJOR EVENTS	Event Type	Date of Event	Intensity	Periodicity
F115-118	**BU WN**	**1920**	**S**	**75**
F119-122				
F123-126				

ANIMAL EVIDENCE F127: **DE** F128: **EL** F129: **CA** F130: ___ F131: ___ F132: ___

EXISTING VEGETATION

Tree: (F133-139)	Total	Seedling	Sapling	Pole	Medium	Large	V Large
	20	**10**	**10**	___	___	___	___

Shrub: (F140-143)	Total	Low	Middle	Tall
	30	**5**	**25**	___

Herb: (F144-147)	Gram	Forb	Fern	Moss
	55	**35**	___	___

F148: **B** Live Life Form		**POTR** F153 Upper Layer Dom Spp	___ F154 Upper Layer Co-Dom Spp
F149: **SA** Live Life Form Size Class	F150: **SA** Dead Life Form Size Class	**ARTRV** F155 Middle Layer Dom Spp	___ F156 Middle Layer Co-Dom Spp
F151: **2** Live Canopy Cover Class	F152: **18** Dominant Layer Height	**PONE2** F157 Lower Layer Dom Spp	**ACLA5** F158 Lower Layer Co-Dom Spp

POTENTIAL VEGETATION

F159: **BF** Formation	F160: ____--__ Classification Reference Identification	
F161: ___ Indicator Species #1	F162: ___ Indicator Species #2	F163: ___ Indicator Species #3
		F164: ___ Site Phase

LIVE TREE	F165: ___ BAF	F166: ___ BAN	___ BA	F167: ___ DBH	F168: ___ Height	F169: ___ Age
DEAD TREE	F170: ___ BAF	F171: ___ BAN	___ BA	F172: ___ DBH	F173: ___ Height	

DRY WEIGHT PRODUCTION

	Grn Wt	DWF	Dry Weight		Grn Wt	DWF	Dry Weight
Tree: F174	___	___	___	Shrub: F175	___	___	___
Gram: F176	___	___	___	Forb: F177	___	___	___
Fern: F178	___	___	___	Moss: F179	___	___	___

RANGELAND HEALTH EVALUATION MATRIX
R2-2200-RH

This form is a "quick and dirty" process of focusing the examiner's eye on critical rangeland health features. Qualitative evaluation of these features can lead the examiner towards an accurate initial assessment of the rangeland and the management of that rangeland.

This checklist is based on Table 4-8 (pages 130-131) of "Rangeland Health: New Methods to Classify, Inventory, and Monitor Rangelands" published in 1994 by the National Academy Press.

COMMENTS DATA
R2-2200-CD

GENERAL DISCUSSION

This form is used to record all comments for a plot, regardless of the types of sampling methods used. The data base allows the examiner to enter as many lines of comments as required. The following data are recorded for Form R2-2200-CD.

Ensure that a complete description of the plot location is included in the comments. A road or trail log, including road/trail numbers, mileages, and direction; reference site description; distance and bearing to the plot center; and plot center description are essential for successfully relocating any plot.

FIELDS 1-7: KEY ID RECORD IDENTIFIER (15-CHAR)

Enter the Key ID identified in Fields 1-7 of the General Field Data Form (R2-2200-GF).

Required.
Accuracy Standards = No Errors.

FIELD 8: COMMENTS (240-CHAR)

This field is used to record up to 240 characters of comments per line number ID. You may enter as many lines of comments as you need in the CD1 data base, despite the fact that the field form only displays eight line record entries. Continue on another field sheet if you need to record additional comments. *NOTE: Always begin your comment entry with the first two characters of the sampling method you are describing. If your comments are not specific to a sampling method, enter G F in the first two characters of Field 8.*

The following is a partial listing of items you should consider for entry into the comments field.

Include comments concerning location, key environmental features, vegetation relationships, history, and disturbance factors not identified in other fields.

Identify adjacent communities and indicate whether they are on wetter or drier sites. Discuss why adjacent communities are different if they are on the same kind of site.

RANGELAND HEALTH EVALUATION MATRIX (R2-2200-RH)

F1-7: F S -- 0 2 -- 0 4 -- 0 9 -- 9 4 -- M B -- 0 8 2

Plot ID Agency Region Forest District Year Exam'r Plot Number

INDICATOR	HEALTHY	AT RISK	UNHEALTHY
	Phase 1: Soil stability and watershed function		
A-horizon	[ ] Present and distribution unfragmented	[ ] Present but fragmented distribution developing	[ ] Absent, or present only in association with prominent plants or with other obstructions
Pedestaling	[ ] No pedastaling of plants or rocks	[ ] Pedestals present, but on mature plants only; no roots exposed	[ ] Most plants and rocks pedestaled; roots exposed
Rills and gullies	[ ] Absent, or with blunted and muted features	[ ] Small, embryonic, and not connected into a dendritic pattern	[ ] Well defined, actively expanding, dendritic pattern established
Scouring or sheet erosion	[ ] No visible scouring or sheet erosion	[ ] Patches of bare soil or scours developing	[ ] Bare areas and scours well developed and contiguous
Sedimentation or dunes	[ ] No visible soil deposition	[ ] Soil accumulating around plants or small obstructions	[ ] Soil accumulating in large barren deposits or dunes or behind large obstructions
	Phase 2: Distribution of nutrient cycling and energy flow		
Distribution of plants	[ ] Plants well distributed across site	[ ] Plant distribution becoming fragmented	[ ] Plants clumped, often in association with prominent individuals; large bare areas between clumps
Litter distribution and incorporation	[ ] Uniform across site	[ ] Becoming associated with prominent plants or other obstructions	[ ] Litter largely absent
Root distribution	[ ] Community structure results in rooting throughout the available soil profile	[ ] Community structure results in absence of roots from portions of the available soil profile	[ ] Community structure results in rooting in only one portion of the available soil profile
Distribution of photosynthesis	[ ] Photosynthetic activity occurs throughout the period suitable for plant growth	[ ] Most photosynthetic activity occurs during one portion of the period suitable for plant growth	[ ] Little or no photosynthetic activity on location during most of the period suitable for plant growth
	Phase 3: Recovery mechanisms		
Age-class distribution	[ ] Distribution reflects all species	[ ] Seedlings and young plants missing	[ ] Primarily old or deteriorating plants present
Plant vigor	[ ] Plants display normal growth form	[ ] Plants developing abnormal growth form	[ ] Most plants in abnormal growth form
Germination micro-site	[ ] Micro-sites present and distributed across the site	[ ] Developing crusts, soil movement, or other factors degrading micro-sites; developing crusts fragile	[ ] Soil movement or crusting sufficient to inhibit most germination and seedling establishment

Overall Rating (Narrative Summary): ______________________________

____

COMMENTS DATA (R2-2200-CD)

F1-7: F S -- 0 2 -- 0 4 -- 0 9 -- 9 4 -- M B -- 0 8 2

Plot ID	Agency	Region	Forest	District	Year	Exam'r	Plot Number
	FS	02	04	09	94	MB	082

F8: Comments (Continue on additional sheets, if necessary.)

1	
2	
3	
4	
5	
6	
7	
8	

RANGELAND MONITORING AND EVALUATION

INTRODUCTION

Rangeland monitoring and evaluation is an essential aspect of good rangeland management. Monitoring and evaluation can be described as the gathering of sufficient information so the manager knows what is happening to the rangeland resources and why it is happening. Goals and objectives in the Forest Plan and Allotment Management Plan (AMP) portray a vision of desired condition of allotment resources. The intent of monitoring and evaluation is to test the success of the prescribed management strategy in accomplishing these goals and objectives.

Rangeland monitoring attempts to analyze effects of management on the entire ecosystem involved. Ecosystem management dictates that monitoring methods be diverse. This Guide sets forth a menu of the most common and acceptable monitoring methods for use in the Rocky Mountain Region. These methods are not necessarily all-inclusive. In many situations, range personnel will need assistance from additional resource specialists to suggest and implement monitoring methods not described in this Guide.

Adequate monitoring programs have value to the Forest Service, to permittees, and to various individuals or groups interested in rangeland resources. Proper monitoring will accomplish the following:

1. Determine permittee compliance with the Allotment Management Plan and Annual Operating Instructions.

2. Verify results against prescribed management objectives. If progress towards objectives is not occurring, the manager can use the monitoring information to adjust the management strategy, or to determine if objectives are unrealistic.

3. Firm up grazing capacity estimates.

4. Provide necessary information to develop annual operating instructions.

5. Identify the need to revise allotment management actions, such as grazing strategy and improvement needs.

6. Supply estimates of trend towards Desired Condition or Desired Plant Community.

7. Determine impacts from livestock and other uses on rangeland resources.

8. Provide a data base of information for reporting.

The intensity of monitoring and evaluation will vary between allotments based upon rangeland conditions, management complexity, conflicting interests, and controversy. Periodic ocular estimates of rangeland conditions may suffice on some allotments, while numerous resource studies involving a variety of methodologies may be needed on other allotments. Tailoring monitoring efforts to each individual allotment is an important component of allotment management planning. In general, monitoring efforts will be greatest during the years immediately following implementation of a new Allotment Management Plan. Usually this will extend through the first full cycle of the management system, at which time the system should be operating smoothly and opportunities for improvement found and applied.

TYPES OF MONITORING

Monitoring can be classified into three types:

IMPLEMENTATION MONITORING

Implementation monitoring determines whether standards and management practices are implemented as detailed in the AMP and Forest Plan. The question asked with this type of monitoring is: "Did we do what we said we were going to do?" Implementation monitoring includes allotment inspections and utilization estimates. Implementation monitoring is *short-term* monitoring.

EFFECTIVENESS MONITORING

Effectiveness monitoring determines whether management practices are effective in moving the allotment towards desired condition as described in the Forest Plan and AMP objectives. The question asked is: "Did the management practices do what we wanted them to do; did they meet the objectives?" An example of effectiveness monitoring is trend studies that determine whether vegetation is moving towards the desired plant community. Effectiveness monitoring is *long-term* monitoring.

VALIDATION MONITORING

Validation monitoring determines whether the information upon which standards, guidelines, and objectives are based is valid and correct. The question asked is "Is there a better way to meet Forest Plan and AMP goals and objectives?" An example of validation monitoring is the continual assessment of proper use guidelines to insure they reasonably describe the level of grazing use which encourages progress towards allotment objectives.

THE ALLOTMENT MANAGEMENT PLAN

Monitoring and evaluation, like all aspects of allotment management, should be carefully analyzed and planned. All Allotment Management Plans will have a monitoring section that describes the specific monitoring methods to be conducted on the allotment (See Planning Chapter). Monitoring allows the manager to determine if the AMP goals and objectives are being met. Following are general guidelines to consider in developing the monitoring and evaluation section of the AMP:

MONITORING GUIDELINES

1. Compliance inspections to determine accomplishment of the terms and conditions of grazing permits, AMP's, and annual operating instructions is a critical monitoring effort. Before range management personnel can make any judgment on the cause of resource impacts or the trend in resource condition, there has to be the assurance that plans were followed as specified.

   Although the Forest Service has the responsibility for compliance monitoring, permittees need to take a more active role. Public scrutiny of rangeland management programs demands that permittees take full responsibility for compliance with grazing permits and relevant management plans. Non-compliance with the terms and conditions of a grazing permit cannot be tolerated nor allowed to continue, and should be followed by permit action. Involvement by the permittee in compliance monitoring will enable Forest Service rangeland managers to spend more of their limited time on planning and implementation of management strategies for allotments not in compliance with Forest Plans.

2. Monitoring techniques that collect measurable resource attributes are more accurate and defensible. Subjective monitoring techniques should be kept to a minimum.

3. The monitoring and evaluation effort should be commensurate with the level of grazing use and the complexity of the overall allotment situation. Realizing the time constraints, personnel, and funding, monitoring should be kept simple and realistic.

4. Develop the monitoring plan as a schedule, with specific assignments, techniques to be utilized, precision and confidence limits, and time frames.

5. **DOCUMENT! DOCUMENT! DOCUMENT!** Each monitoring section should identify how and where the monitoring information will be recorded and filed.

6. The monitoring section will be developed jointly with permittees and other interested persons or groups. Some monitoring efforts can, and should, be assigned to the permittee or others. The Forest Service is responsible for ensuring that monitoring by others meets specified standards and is documented appropriately. Monitoring techniques that determine range readiness and utilization levels are easily learned and quickly accomplished through a partnership approach with permittees or others.

KEY AREAS AND BENCHMARKS

The use of key areas and benchmarks allows for sampling of relatively small areas of the allotment and extrapolation of the results to much larger areas. The key area and benchmark concept is based on the premise that evaluation of correctly identified small areas are reliable indicators of grazing impacts on the entire unit or allotment. Depending on management objectives, benchmarks and key areas may be representative samples of a large stratum such as a pasture or allotment, or they may be representative of a much smaller area with important value such as a riparian zone, critical nesting habitat for grouse, or a special plant community.

Benchmarks and key areas are selected because they provide valuable resource information. Range personnel should be aware of disturbances or changes in livestock use patterns that may cause the areas to no longer be representative. Benchmarks and key areas may need to be changed or new ones selected when the pattern of use is significantly modified because of differences in season of use, kinds and classes of livestock, pasture size, and water supplies. Keep information from abandoned benchmarks or key areas to provide a historical background for future analysis.

In many cases the benchmarks and key areas identified for resource inventory can also be used for monitoring. Delineate benchmarks and key areas accurately on aerial photos and the allotment map. Benchmarks and keys areas have slightly different meanings and purposes.

Key Areas

Key areas are defined as:

> "...a portion of the range, which, because of its location, grazing or browsing value, and/or use, serves as an indicative sample of range conditions, trend, or degree of use seasonally. A key area guides the general management of the entire area of which it is part." (SRM 1974).

Key areas are usually selected for monitoring studies to determine if management objectives are being met.

Key areas are usually 5 acres or more and are selected as sites where prescribed use will occur first. Also included are sites where use must be closely monitored because of management plan requirements, such as riparian areas or areas where threatened, endangered, or sensitive species may occur. These locations will vary by grazing strategy. There will probably be several key areas per allotment. Locations of key areas should be identified in the allotment management plan and delineated on the allotment map.

Benchmarks

Benchmarks are reference points which are sensitive to management changes. These are the small areas where *long-term* trend studies are installed and maintained so that the manager can assess the resource impacts from management.

Selection of benchmarks for long-term trend studies is an important task, and should be carefully evaluated. Benchmarks should be selected by experienced personnel familiar with the allotment. There should be agreement on the locations of benchmarks with permittees, and other interested agencies and individuals. Interdisciplinary team personnel should also be involved with selection of benchmarks, and the types of studies to be conducted in their related field of expertise. Benchmarks should be representative of the area in which they are located. They should be located away from fence lines, roads, salt grounds, water developments, recreation facilities, and other features that may concentrate use or otherwise cause disturbance.

The ecological characteristics of the benchmark site should be well understood, including existing vegetation, ecological type, and wildlife species using the area. Evaluation and adjustments in the management system should only be made by persons with a working knowledge of the entire ecosystem.

Statistical Considerations for Monitoring

Rangeland management is both an art and a science. In other words, good management can only occur through professional judgment based upon precise data. Information based upon judgment should not be confused with information collected through scientific study. It should also be clear that good decisions are based upon a combination of both judgment and science, never one exclusive of the other. Managers must make every effort possible to insure *all* information used to make decisions is correct.

Many monitoring methods discussed in this Chapter (specifically rangeland use and trend determinations) are for plot level sampling of vegetative characteristics. The rangeland manager and decision maker must be reasonably sure that the data collected through sampling accurately represents the overall population. Appendix C contains the necessary information that rangeland managers can use to support their decisions with statistical analysis.

SHORT-TERM MONITORING

Short-term (implementation) monitoring methods described in this Guide include: Range Readiness, Allotment Inspections, Forage Production, Vegetative Residue Methods, and Utilization Methods.

Range Readiness

Early spring use by livestock on most National Forest range allotments with traditional, continuous, deferred, or rest rotation grazing systems can be detrimental to vegetation reproduction and establishment of new plants. Indicators used to determine range readiness are soil and vegetation conditions. Rangeland is generally ready for grazing when soil has become firm after winter and early spring precipitation, and when plants have reached the defined stage of growth at which grazing may begin under a specific management plan without long-lasting damage. Rangeland is generally ready when cool-season grasses are headed out, forbs are in full bloom, and brush is leafed out.

The concept of range readiness has changed somewhat in current years. Application of Holistic Management (Savory), riparian management techniques, and livestock grazing to improve forage

quality for wintering wildlife has demonstrated that livestock use prior to traditional range readiness can actually benefit rangeland conditions. The key to the success of these new management systems is the ability to graze the important forage species early and then allow sufficient regrowth before further use. Range readiness dates will vary between allotments with differing resource attributes and management systems. Before establishing turn-on dates that are earlier than traditional range readiness, the rangeland manager must be reasonably certain that the proposed management strategy will work. Early turn-on dates must be based upon documented successes in other areas with similar vegetation types and similar objectives.

Establishment of a range readiness date should be developed during the allotment management planning process. Select representative areas of the primary range for range readiness observation. Properly selected, a location may furnish data for several allotments which are uniform in elevation, exposure, soil, vegetation, climate, and prescribed management system. Successive annual observations will indicate validity of opening dates. Record range readiness observations in field inspection notes.

ALLOTMENT INSPECTIONS

Allotment inspection is an on-the-ground (and "off the main road") visit of the grazing allotment. A number of items will be monitored during each allotment inspection; however, compliance with the terms and conditions of the grazing permit(s) is the primary objective. Allotment inspections must be documented in writing. Allotment Inspection Forms of local design should be used for recording pertinent information collected during the inspection. Annual allotment inspections, including suggestions, should be consolidated and submitted to the permittee for review at the end of the season. Use of photographs or video recordings can be used to greatly enhance the documentation.

The objectives or items that you want to monitor should be decided prior to visiting the allotment. Items to be inspected include:

Livestock Management

1. Determine livestock ownership through brands and eartags.

2. Conduct livestock counts, to insure stocking does not exceed permitted numbers or is not less then 90 percent of permitted numbers.

3. Validate management system compliance, including if livestock are in the correct pastures for the correct season.

4. Verify that maintenance of range improvements is satisfactory; also note need for reconstruction of improvements and ideas for potential improvements such as water sources and fences.

5. Inspect salting locations; identify recommended salting areas which will encourage better livestock distribution.

6. Determine if sheep bedgrounds are properly located and used.

7. Determine livestock distribution by describing locations and general use levels.

8. Evaluate herder or rider performance.

9. Document contacts with the permittee(s).

Range Vegetation

1. Estimate forage utilization and/or forage residue. Sketchings on a map of use intensity or forage residue levels are generally preferable to notes for recording this information.

2. Estimate vigor of individual plant species. Seed production, seedling establishment, dead plant centers, and other general vegetation health characteristics are important items to observe when estimating vigor.

3. Note phenology of important forage species such as specific flowering and seed maturity dates.

4. Record noxious weed, rodent, insect, and poisonous plant infestations and delineate their locations on a map for future planning and control efforts.

Other Resource Considerations

1. Observe wildlife numbers and use patterns. Special attention should be placed on identifying threatened, endangered, or sensitive species that may exist in the area.

2. Note soil conditions by assessing relative amount of displacement, compaction, rilling, gullying, surface soil losses and deposits, accumulation of litter, and other indicators.

3. Inspect special concern areas to ensure that livestock are not in closed areas, such as campgrounds or Research Natural Areas.

4. Note impacts to rangeland resources from other users, such as recreationists or off-road vehicles.

5. Document riparian values and water quality including bank stability, apparent stream siltation, kinds and vigor of shrubs, and livestock/wildlife use patterns in riparian areas.

This list is not all-inclusive since there are numerous things encountered during an allotment inspection. An allotment inspection may be the only time a Forest Service employee visits the area during the year, so it is important to observe and document all activities and occurrences on the allotment.

The examiner should be familiar with the grazing permit, the AMP, and the annual operating instructions prior to making the examination. Knowledge of travel management regulations, wildlife management objectives, and recreation values is also desirable when performing an inspection. Take a map along to record locations of observations. Concise documentation is best, portraying facts, figures, measurements, people, and dates. Include as many specifics as possible and avoid generalities. Proper documentation is necessary to evaluate the effectiveness of the AMP, and may even be used in a court of law.

Include the permittees in allotment inspections when possible. Aside from insuring that you are both looking at the same things, these are good opportunities to exchange viewpoints, share information, and get to know each other. Open and honest communication during an allotment inspection can go a long way towards solving problems and designing management strategies that will help to move the range resource towards its desired condition.

FORAGE PRODUCTION

Forage production is current growth of browse and herbaceous plants that is both palatable and available to grazing animals. Forage may vary with season of use and kind of livestock. Forage production estimates are primarily an inventory procedure (see page 3-95, Inventory Chapter). Forage production measurements can also be an important part of monitoring if the observer recognizes the limitations.

Forage production fluctuates greatly with changes in climatic conditions. Reliable information can only be obtained from many years of production monitoring spanning climatic cycles. Estimating forage production alone is a poor method of determining stocking rates on allotments with a history of livestock use. On existing allotments, stocking rates should be determined by a combination of forage production, livestock use patterns, and trend determinations.

There is some value however, in using forage production estimates as a factor in establishing initial grazing capacity on areas without a history of grazing use. As we continue to analyze rangelands from an ecosystem (landscape scale) perspective, vegetative production will also be useful in defining resource value ratings (production potentials) for the various plant communities that may occur within an ecological type.

Production should be measured according to the procedures outlined in the Inventory Chapter (see page 3-95).

RANGELAND USE

Determining the use of rangeland forage by all herbivores is an important aspect of management. The manager needs to know when use is occurring, to what extent, and by which animals. Use data helps the range manager assess the degree of livestock use that is desirable in moving resource conditions towards the objectives described in the Allotment Management Plan. The level of use, timing of use, and the grazing system in place will determine how individual plant species are affected by livestock grazing. Use by livestock is one factor influencing trend that can be readily adjusted. Use is also one of many considerations when determining grazing capacity. Rangeland use data is intended to provide the rangeland managers (Forest Service and permittees) with information that can be used to: determine timing of pasture moves, identify distribution problems, and develop future management actions such as grazing strategies and potential improvements.

Rangeland use can be measured and expressed in two ways: the amount of forage left after grazing (residue), or the amount of forage removed by grazing (utilization). In the past, the Forest Service has primarily used utilization methods in determining rangeland use. Residue methods, by contrast, are relatively new procedures for most National Forest System lands. Residue methods and utilization methods are discussed in this Chapter.

Vegetative Residue

There has been increasing interest from the livestock industry and various resource specialists in describing proper use in terms of residue, or the amount of forage left after grazing.

Rangeland values vary considerably between geographic locations. Allotment objectives are developed to enhance and protect different resource values on each allotment. Because of specific resource values, rangeland use might be more appropriately expressed by the amount of "standing crop" left after grazing, instead of the percentage of forage removed by grazing. Examples of this may occur on rangelands where the amount of vegetation left ungrazed is the critical factor in successful bird nesting or wildlife winter range. Another example might be on locations where a certain amount of herbage must be left to protect fragile soil from excessive erosion.

Residue guidelines should, at minimum, protect the basic health and productivity of range and watershed resources. Increased residue could incorporate the needs of wildlife, fisheries, and aesthetics. While traditional utilization measurements are aimed entirely at key species, residue methods may measure key species or the total standing crop, regardless of species.

Residue methods are simple, quick, and accurate. These methods can be used to monitor large areas in less time than with traditional utilization methods. Statistical reliability improves because numerous measurements can be taken in a relatively short time. Limitations of these methods may stem from infrequent application in a variety of rangeland ecosystems. While residue methods have been used with great success on the Great Plains, there needs to be more research on the use of residue methods in a variety of plant communities and ecosystems in the National Forest System.

Testing these methods is strongly encouraged in this Region due to the potential advantages. These methods are easily learned and can be easily accomplished by permittees and other interested groups

and individuals. Residue sampling methods approved for use in the Rocky Mountain Region include: Stubble Height (page 4-21), Herbage Left Ungrazed (page 4-25), and Visual Obstruction Methods (page 4-29).

Vegetative Utilization

Utilization is expressed as a percentage of available forage weight that has been consumed or trampled. Utilization estimates are in terms of the current year's biomass removed. Utilization measurements should be confined to forage species, not total herbaceous vegetation. Generally, only plants of selected key species are monitored. This does not preclude sampling plants of other species on the key area if additional data is needed.

Utilization studies are conducted as frequently as needed to satisfy data requirements for the allotment. It may be necessary to conduct utilization monitoring at various intervals throughout the grazing season to adjust pasture rotations. Monitoring of utilization is needed annually until objectives listed in the AMP are achieved. Utilization monitoring requirements are unique to each allotment and should be developed to aid in accomplishing allotment objectives.

Measure utilization soon after livestock are removed from the allotment or unit (not more than a week) to eliminate bias due to regrowth. This is especially important on bluegrass bottoms, riparian areas, and mountain meadows where regrowth occurs fairly rapidly. If utilization is used as a guide for moving livestock from one unit to another, utilization estimates should be made far enough in advance to insure movement at or prior to the desired use level. Timing of measurements is critical in furnishing the data needed to adjust permitted use or obtain improved distribution of livestock within the current season.

Weight is not evenly distributed in most plant species. A higher percentage of the weight is in the basal portion of the plant where growth is thicker and more dense. A lower percentage of the weight is in the upper portion of the plant where growth is tapered and less dense. Weight distribution in relation to height is reasonably constant among plants of the same species.

Plant regrowth occurs following an interruption of growth by grazing, fire, or other disturbance. Regrowth can also occur in response to favorable weather events following the normal growing season. When animals use the same area more than once a year and

plant regrowth occurs, utilization is still based on the amount of available growth at the time the data are collected. The percent utilization after each use period represents only the amount of available growth that has been utilized up to the time the studies are conducted. Utilization percentages or stubble heights for various use periods during the grazing season cannot be added together to get total utilization for the year. As an example, 30 percent utilization of 6 inches of plant growth available in the spring, and 30 percent utilization of 12 inches of plant growth in the fall, do not add up to 60 percent utilization for the year.

Monitoring of browse utilization is an important aspect of rangeland management. It is important to know how much use is occurring and which animals are using the browse. Use the ocular estimate method on page 4-51 for browse utilization estimates.

Utilization Monitoring Methods

Utilization monitoring methods approved for use in the Rocky Mountain Region are: Paired-Plot Method (page 4-35), Utilization Gauge (page 4-41), and Ocular Estimates (page 4-51). No one method is preferable in all situations. Each method has advantages and disadvantages which must be considered with respect to the area and purpose for which the study will be conducted.

OTHER UTILIZATION METHODS

There are several methods for determining forage utilization that are available but not discussed in-depth in this Guide. This Guide addresses only methods deemed as most appropriate for this Region. These methods are consistent with those contained in range analysis handbooks from other Regions and agencies. Other methods can be used if they have been subjected to peer review, published in a scientific journal, and approved by the Regional Forester of the Rocky Mountain Region.

LONG-TERM TREND MONITORING

Probably the most important role of monitoring is to determine whether management is successful in moving rangeland resources towards the objectives (effectiveness monitoring). Determining the "trend" toward or away from allotment objectives allows the range manager to accurately determine the relative success of the management system and adjust management to speed the accomplishment of objectives. Trend in a variety of rangeland resource parameters may need to be monitored.

This Guide will describe the accepted methods used to determine trend in vegetative and soil characteristics. Determining vegetative trend includes such characteristics as species composition, density, cover, vigor, production, and frequency. Determining trend in soil conditions will include ground cover and status of erosion. Trend data is considered along with actual use, authorized use, utilization, climatic cycles, and other resource activities and impacts, in designing and adjusting the management strategy. Permittees and other interested parties should be encouraged to become active partners in monitoring trend.

Early detection of trend involves some risks because vegetative characteristics naturally fluctuate widely within and among years due to climatic variability and other influences. These normal fluctuations must be considered when determining trend.

Apparent Versus Measured Trend

Apparent trend is the interpretation of direction of change based on professional judgment during a single observation. Apparent trend results are highly subjective and depend to a great extent on the experience of the observer. Apparent trend is useful in early detection of problems, and is a precursor to measured trend studies.

Measured trend is a quantitative assessment of change based on repeated measurements over time of the characteristics and amount of plant species and soil surface properties. It provides quantitative data for interpreting the direction of change, often before it is detectable by repeated ocular examinations or repeated photos over time. Measured trend provides feedback to indicate whether management objectives are being attained. If progress is unsatisfactory, modification in management practices is needed.

Frequency of Studies

Trend studies are conducted as frequently as needed to satisfy data requirements for the allotment or designated management area. They are generally conducted at intervals in sequence with grazing treatments. For example, trend studies could be conducted once every three years on a three-pasture grazing system and once every five years on a five-pasture rotation system. Where studies are conducted only once during the grazing cycle, they should be conducted at the same point in each cycle so that the data will be comparable. Because limited resources often dictate that trend monitoring will be done infrequently, a monitoring strategy designed to aid in accurate identification of trends and their causes is important. The following are ways to overcome infrequent measurement:

1. Select a few locations for frequent measurement. The location chosen should be where collateral information relative to management objectives can be obtained. Establishment of a continuous trend in soil/vegetation characteristics in relation to weather, utilization, actual use and other variables will support a more accurate interpretation of data gathered on an infrequent basis elsewhere.

2. If vegetation cover is declining at numerous trend locations regardless of the management system, it may be assumed that weather or factors other than management are responsible. However, if cover of forage species declines on an ecological type in one management unit but increases or is static on the same ecological type in an adjacent unit, a change in management is indicated.

TIMING OF STUDIES

Trend studies should be started before initiating management under a new or revised Allotment Management Plan. This is to ensure that there is a record of the resource situation prior to changes in management. Trend data should normally be collected after the growing season when the majority of plants have reached their maximum growth. However, certain plant communities and environmental influences may require that pictures be taken and measurements recorded at different times during the growing season. In order to obtain the best data, trend studies should be conducted on ungrazed pastures to the extent possible. It is important that once the time for trend studies has been selected, the follow-up studies in succeeding years be conducted at the same time (phenologically) during the growing season.

INTERPRETING TREND DATA

Changes in kind, proportion and/or amount of plant species on a site or in soil cover characteristics are interpreted as trend in vegetation management status. To decide if a change in management is needed to reverse undesirable trends or to accelerate desirable ones, the causes of trends need to be established. Annual precipitation and growing conditions should be compared to the averages for the area. The following are guidelines for collection and interpretation of trend data.

Interpreting Trend at One Location

Differences in measurements obtained because of sampling error, personal bias, or lack of adequate training should be minimized. The location and size of the sample area must be adequately determined and specified. The sample area should not involve more than one ecological type and sampling design should account for heterogeneity in plant pattern, topography, and micro climate.

Interpreting Trend in a Management Unit

It is rarely feasible, nor is it necessary, to obtain a statistically valid sample of an entire management unit for trend monitoring purposes. Each monitoring location should be carefully selected with specified objectives developed for each location. Data from different sample locations should not be combined until after interpretation of each location is made and then only if it is certain no information will be lost. The overall trend on a management unit cannot be determined by averaging trend data from various locations except perhaps where the various locations are similar ecologically.

Collateral Data

Collection of collateral data to aid interpretation of soil or vegetation change is essential.

1. Weather data should be collected on or near each monitoring location. National Weather Service or Forest Service storage gauges read monthly or seasonally can be used for precipitation. Max-min thermometers at selected locations may help explain extreme events. The years that trend measurements are made should be compared with averages for the area before trend estimates are made.

2. Actual records of livestock and wildlife use should be maintained.

3. Utilization should be measured on each monitoring location whenever trend data are collected and at other times when appropriate and feasible. Any of the residue or utilization methods described in this Chapter can be used.

4. Observations on populations or occurrence of rabbits, rodents, insects, fire, or other disturbances should be documented.

COMPLETED TREND STUDY REQUIREMENTS

A trend study must be properly planned, implemented, analyzed, conclusions made, and documented. The study should involve:

Proper Planning

The Allotment Management Plan should have a monitoring section describing how allotment objectives will be monitored. The monitoring section will describe what trend method is most appropriate for the particular allotment, who will perform the trend monitoring, and when the monitoring will be accomplished.

Properly Collected Field Data

Field data should be collected utilizing accepted methods. Instructions should be taken to the field to insure consistency with regional standards and between different observers. Key areas and Benchmarks should be established and identified on aerial photos and allotment maps. All data forms should be completed and summarized in the field. Photos should be taken and labeled for easy reference.

Proper Documentation

Trend monitoring is not complete until the data collected is properly analyzed and conclusions made. Perhaps the most important aspect of trend monitoring is to summarize the data in a clear and useful package so that resource managers can make reasonable management decisions based upon the information. All trend data, summary sheets, pinpricked aerial photos, descriptions of study areas, mounted photographs, and narrative information should be compiled, summarized, and placed in the files. The folder should be marked "Permanent Record, Do Not Destroy". Two complete sets of the study should be made; one set should stay in the District files, while the second set should be submitted to the Supervisor's Office.

SELECTING A METHOD

No single method of vegetation sampling for trend determinations is suitable for all vegetative types and management situations. Selecting a sound sampling method is critical to the success of a study. Trend methods must be sensitive to changes in the plant community, and should be unbiased, efficient, and cost-effective. Carefully consider the advantages and limitations of each method in respect to the type of vegetation on which the studies are to be conducted, and the type of study needed to determine if specific objectives are being met. Measurement of more than one

characteristic of the vegetation or soil will provide a more complete picture of trend. A combination of methods can be used when appropriate to yield more informative and reliable data.

Permanent Versus Temporary Transects and/or Plots

One of the most important decisions to be made regarding trend studies is the permanence of transect or plot installation. Permanent transects should be located on benchmarks representing the entire site. Temporary transects should be installed within key areas that are well-defined and shown on the allotment map. Following are some guidelines to consider when deciding upon trend transects:

1. A mix of both permanent and temporary transects is recommended for allotments where trend information is needed. Long-term trend studies using permanent transects supply the most reliable data.

2. Temporary transects are quickly installed and read. Several temporary transects can often be measured in the same amount of time required to locate and read one permanent transect. Temporary transects are located randomly within a key area and should be established using the same methodology as permanent transects, except that no stakes or permanent markers are used. Temporary transects are not paced transects, since a tape is always randomly laid out and plots read along the tape. Using the tape greatly eliminates the bias inherent with paced transects.

3. Permanent transects should be established with beginning and ending points permanently marked. The transects should be marked so they are easily located in the future. Inventory crews should use the Global Positioning System (GPS) to locate and relocate permanent transects. Range managers must make every effort to get training and use GPS technology where possible. Photos attached to the permanent transects should clearly indicate significant changes in vegetation.

Trend Sampling Methods

There are several sampling methods for determining trend in vegetative and soil characteristics within the Rocky Mountain Region. Approved methods include:

1. Cover-Frequency Transect Method (page 3-57),
2. Line Intercept Method (page 3-73),
3. Rooted Nested Frequency (page 4-65), and
4. Shrub Density and Age/Form Class (page 3-87).

GRAZING CAPACITY DETERMINATION

Resource conditions on some allotments within the Rocky Mountain Region are not meeting, nor moving, towards Forest Plan objectives. These situations are identified through inventories of existing conditions and by reviewing past trend data. When these situations occur, rangeland managers should re-evaluate grazing capacity. Grazing capacity is the amount of livestock use that can be allowed while meeting basic resource needs and associated allotment objectives. Since grazing capacity determinations can greatly affect permittees and local economies, it is essential that capacity estimates be made only after intensive study over several years.

PRODUCTION-UTILIZATION SURVEYS

Production-Utilization surveys are intensive, time-consuming, and require long-term commitment of time and funding. P-U studies are only recommended where reductions or increases in permitted use is obvious, and no other alternatives exist to bring resource conditions into compliance with allotment objectives. Studies should be conducted for at least 3 years on season-long allotments and for a full rotation on rest or deferred systems. The schedule should be sufficient to allow for vegetative production fluctuations due to climatic conditions. Accurate actual use records must be kept during study years. Production-Utilization surveys are described on page 4-89.

FURTHER GRAZING CAPACITY CONSIDERATIONS

Production-Utilization studies are only *one* factor in establishing grazing capacity. As with any study, Production-Utilization can only be used as a guide to stocking. Ultimately the true grazing capacity for an area will depend upon a variety of factors including: climate, type and breeds of livestock, the management system,

permittee involvement, improvements, and many others. Trend towards objectives is the primary consideration used in adjusting stocking rates. Capacity estimates will not be considered as static. Estimates shall be periodically reviewed and adjusted to bring them in line with changing conditions. Stocking rates must allow a safety margin to provide for low forage producing years. The quality of management and system of use also has a marked effect on grazing capacity.

STUBBLE HEIGHT
R2-2200-SH

GENERAL DISCUSSION

Stubble height, or inches of herbage left ungrazed, is becoming a well-accepted method of expressing desired rangeland use. Although stubble height standards and measurements have been primarily limited to riparian areas, they may also be applicable to many upland plant communities. The development of stubble height standards and further refinement of this method is strongly encouraged.

Adequate stubble height on streamside areas is needed at the end of the grazing period, or at the end of the grazing season, for maintenance of plant vigor and stream bank protection, and to aid in holding sediments for rebuilding degraded stream banks. As a minimum, stubble height measurements should be made along the green line of key riparian complexes which reflect effects of current management systems in a grazing unit.

TRAINING

This method requires measuring stubble heights of selected key species. Training is minimal. Measuring stubble height can be done by Forest Service personnel, permittees, or non-technical individuals.

PERSONNEL AND EQUIPMENT

This method can be done by one, or preferably two, individuals. Equipment needed includes a tape measure and the Stubble Height Form (R2-2200-SH).

SAMPLING PROCEDURE

Examiners must be able to identify plant species both before and after they are grazed and understand the green line concept in riparian monitoring. Measurements need to be made on key riparian areas that have been cooperatively identified between users and interdisciplinary teams. The Riparian Ecosystems Chapter (Chapter 5) is devoted entirely to inventory and monitoring techniques for riparian areas. Riparian plant species whose stubble height will be monitored and measured should also be cooperatively agreed upon. Normally, several plant species need to be monitored.

Sampling should be done along both sides of a 363-foot stream segment. This is the same monitoring unit as in the green line trend studies described in the Riparian Ecosystems Chapter. At every tenth step along this sampling unit, record the stubble height of the key species that is nearest to the toe of your right foot. This will result in a total of approximately 36 samples (eighteen on each side of the stream) along the green line monitoring segment. An average of the 36 samples will be indicative of the stubble height remaining for that species. Use R2-2200-SH for recording stubble heights.

Through an interdisciplinary process, a preferred stubble height should be specified for each riparian community complex. For example, a stubble height of 3 to 4 inches may maintain plant vigor, provide stream bank protection, and hold sediments to rebuild degraded stream banks. Experience in the Intermountain Region indicates that a 4-inch stubble height on early use pastures, where some regrowth is expected, is generally adequate to accomplish most riparian objectives. Increased stubble height standards, such as 6 inches or greater, may be needed in late use pastures or to protect special ecosystem characteristics such as critical fisheries.

STUBBLE HEIGHT (R2-2200-SH)

Forest GM/UNC/GUNN NF	District TAYLOR RIVER RD	Plot ID
Allotment Name and Number EAST FORK	Pasture WILLOW SPRING	
Kind/Class & Number of Animals 198 C/C	Period of Use 7/1 - 8/1	Actual Use 198 Animal Months
Date 08/04/1994	Examiner(s) MJB	

	1	2	3	4	5	6
Site (or)						
Species	DECE	CANE2	POPR			
1	4	3	2			
2	7	5	3			
3	6	6	4			
4	8	4	2			
5	2	2	4			
6	5	1	4			
7	3	7	5			
8	6	4	3			
9	9	3	3			
10	4	3	5			
11	4	5	3			
12	3	6	6			
13	2	4	5			
14	5	2	4			
15	4	4	5			
16	2	4	5			
17	3	3	4			
18	6	6	2			
19	2	6	1			
20	7	5	5			
21	4	3	4			
22	5	2	4			
23	3	4	5			
24	6	3	4			
25	5	3	4			
26	3	5	3			
27	6	5	3			
28	6	7	5			
29	2	6	4			
30	5	4	2			
31	3	2	2			
32	5	2	3			
33	6	4	2			
34	4	2	2			
35	4	3	1			
36	5	4	4			
Total	164	142	127			
Average	4.6	3.9	3.5			

(Record averages on back of form.)

Stubble Height Summary

Average stubble height for site or species 1	**4.6**
Average stubble height for site or species 2	**3.9**
Average stubble height for site or species 3	**3.5**
Average stubble height for site or species 4	
Average stubble height for site or species 5	
Average stubble height for site or species 6	
Σ for all sites or species	**12.0**
Average for all sites or species	**4.0**

HERBAGE LEFT UNGRAZED METHOD
R2-2200-HU

GENERAL DISCUSSION

To meet the needs for range forage perpetuation and improvement, soil cover for watershed protection, wildlife habitat, and other needs, it may be desirable to measure the total amount of herbage (in pounds/acre) that is left ungrazed. Forests and Districts should develop minimum and optimum standards for herbage left ungrazed as fits the local situation. Standards must not be arbitrary and should be based on scientific evidence that indicates the amount of herbage needed to achieve specific objectives.[1]

TRAINING

The Herbage Left Ungrazed Method does not require intensive training. Examiners can develop their "eye" for accurate estimates with a small amount of experience.

PERSONNEL AND EQUIPMENT

With a small amount of training, an individual can work independent of others with little supervision. Grass clippers, a plot frame, paper sacks, spring scales (calibrated in grams), and a map of the allotment or area to be sampled is needed. Form R2-2200-HU is used for recording herbage left ungrazed data.

[1]Bement, R.E. 1968. A stocking-rate guide for beef production on blue grama range. Journal of Range Management, November 9, 1968.

SAMPLING PROCEDURE

The procedure for measuring herbage left ungrazed is:

1. Clip and weigh several (3-5 is usually adequate) random plots in each sample area to determine the pounds of forage left after grazing. A sample area is a small area with a uniform amount of herbage remaining. Estimates of herbage remaining is usually for all forage species combined. Any of a variety of plot shapes and sizes can be used. Forage will be weighed to the nearest 5 grams and converted to pounds/acre using the conversion rates in Table 4-1. Estimates should be corrected to give air-dry forage produced. Table 3-9 (see page 3-97) provides factors for converting green field weights to air-dry weights.

2. Ocularly estimate the herbage left ungrazed over the remainder of allotment, unit, or area based upon the clipping results in the sample area.

3. Transfer the herbage left ungrazed data to the allotment map, identifying zones or areas with similar amounts of herbage remaining.

Table 4-1. PRODUCTION CONVERSION RATES

Plot frame			Multiply grams weighed in order to determine:[2]	
			lbs/ac	kg/ha
Rectangle:	20x50 cm.	(.1 m^2)	89.2	100.0
Square:	50x50 cm.	(.25 m^2)	35.7	40.0
Circle:	radius 6.6 in	(0.96 ft^2)[3]	100.0	112.9
Circle:	radius 21.0 in	(9.6 ft^2)[4]	10.0	11.2

[2] kg/ha x .9 = lbs/ac

[3] The 0.96 ft^2 circle can be constructed by using 41.7in of cable.

[4] The 0 9.6 ft^2 circle can be constructed by using 131.8in of cable.

HERBAGE LEFT UNGRAZED (R2-2200-HU)

Forest	District	Plot ID
GM/UNC/GUNN NF	TAYLOR RIVER RD	

Allotment Name and Number	Pasture
EAST FORK	WILLOW SPRING

Kind/Class & Number of Animals	Period of Use	Actual Use
198 C/C	7/1 - 8/1	198 Animal Months

Date	Examiner(s)
08/04/1994	MJB

		1	2	3	4	5	6
Site (or)							
Species		DECE	CANE2	POPR			
1	GW	2.1	1.1	0.9			
2	GW	1.4	0.9	1.1			
3	GW	1.8	1.6	0.5			
4	GW	1.2	2.2	1.9			
5	GW	1.9	1.3	1.8			
6	GW	2.7	3.1	1.4			
7	GW	1.0	1.1	0.6			
8	GW	0.4	0.9	0.6			
9	GW	1.1	0.7	1.0			
10	GW	1.7	1.4	0.9			
Average GW		15.3	14.3	10.7			
DW Factor		0.6	0.6	0.6			
Average DW		9.2	8.6	6.4			

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VISUAL OBSTRUCTION METHOD
R2-2200-VO

GENERAL DISCUSSION

This method is used primarily for determining standing biomass on an area. The method has been primarily used to determine the quality of nesting cover for birds on the Great Plains, and is commonly referred to as the Robel Pole Method. This method is applicable to other ecosystems throughout the Region where height and density of cover is important.

TRAINING

Anyone that has used the Robel Pole can train others to use it in five minutes or less, provided the cover classes for the area have been established.

PERSONNEL AND EQUIPMENT

A Robel Pole, aerial photographs or allotment map, cover classes for the area or community being sampled, and Form R2-2200-VO are needed for the examiners to complete the transects.

SAMPLING PROCEDURE

The sampling process includes the following steps:

1. Determine proper residue guidelines. These guidelines should be developed during the allotment planning process and documented in the AMP. Height-Density guidelines should be expressed in inches of desirable cover.

2. Establish cover classes for the area or plant community being sampled based upon resource objectives. Table 4-2 shows cover classes used on the Fort Pierre National Grassland for upland bird nesting cover. These cover classes are displayed only as an example. Cover classes must be developed locally, based upon objectives.

Table 4-2. UPLAND BIRD NESTING COVER CLASSES, FORT PIERRE NATIONAL GRASSLAND

COVER CLASS	AVERAGE HEIGHT-DENSITY
Sparse	0.0-1.9
Light	2.0-2.9
Moderate	3.0-3.9
Heavy	4.0 +

3. Delineate units of similar cover levels on aerial photos or the allotment map. These units of similar cover should be obvious to the observer. No attempt should be made to subdivide areas with complex utilization/cover patterns.

4. Locate line transects within each cover unit. A minimum of two transects is needed for each unit; more may be necessary to provide greater accuracy. Transect locations are randomly selected using a grid with 0.25 mile coordinates and are perpendicular to the predominate slope. Twenty-five stations of the visual obstruction (Robel) pole are located along the transect, every 10 paces (20 steps).

   A diagram of the pole and instructions on how to construct them is shown in Figure 4-1. Two height-density (HD) measurements are taken at each station from opposite directions along the contour. The last 1-inch band totally or partially visible is recorded as the HD, and the average HD for the transect (n=25) is calculated.

5. Record the average HD for each cover unit on the photo or allotment map. Form R2-2200-VO is used to record HD data.

In studies using this method, visual obstruction measurements can also be correlated to the weight of vegetation.[5] The relationship of HD to biomass can be easily determined by clipping about twenty 20x50 cm rectangular (or similar size) plots centered on the pole reading location. The numbers can be plotted on graph paper.

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[5]Journal of Range Management, 1970, Volume 23, page 295

The plots should be deliberately selected to cover the range of vegetation on a site. These relationships appear to be specific to given types of sites and/or vegetation types. A line that best fits the data plot is drawn in or can be calculated using linear regression techniques.

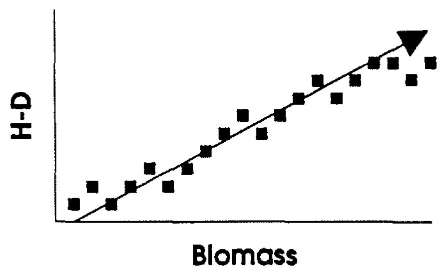
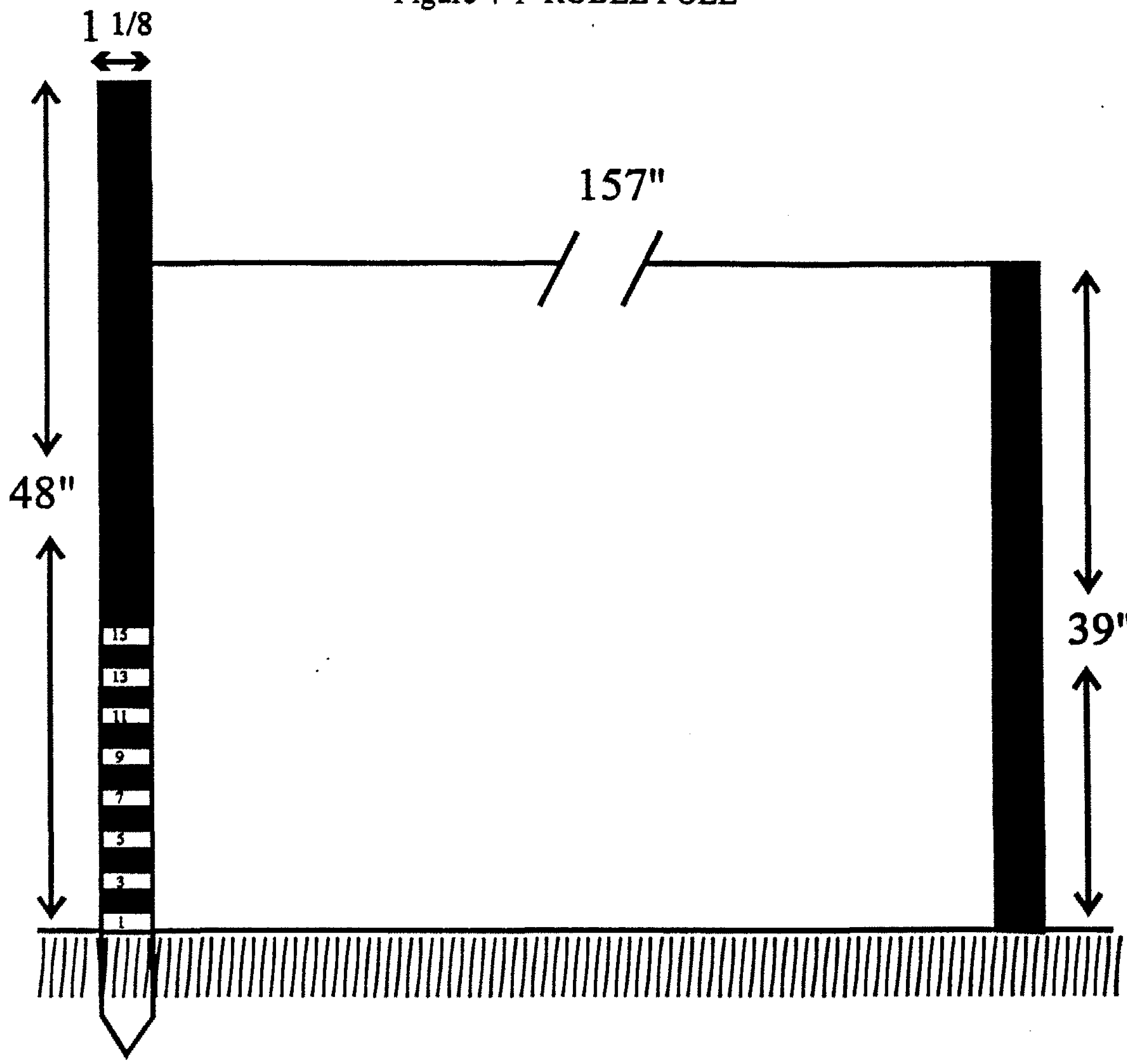


Figure 4-1 ROBEL POLE



1. Pole is 1.125 inch diameter and 48 inch long.

2. Pole is painted with alternating 1-inch bands of flat white and gray colors, starting with white on the bottom.

3. A single cord 157 inch (4 m) is attached to the pole at a height of 39 inch (1 m) to standardize the distance and height that readings are taken.

4. Narrow black numbers corresponding to the number of bands are painted on the white bands. For example, the bottom white band is "1", the next white band is "3", and so on.

VISUAL OBSTRUCTION METHOD -- (ROBEL POLE) (R2-2200-VO)

Forest	District	Plot ID
GM/UNC/GUNN NF	TAYLOR RIVER RD	

Allotment Name and Number	Pasture
EAST FORK	WILLOW SPRING

Kind/Class & Number of Animals	Period of Use	Actual Use
198 C/C	7/1 - 8/1	198 Animal Months

Date	Examiner(s)
08/04/1994	MJB

Sampling Interval = 10 paces

Transect	# - 1		# -		# -		# -	
Station	H-D	H-D	H-D	H-D	H-D	H-D	H-D	H-D
1	1	3						
2	2	4						
3	1	1						
4	2	1						
5	3	1						
6	1	2						
7	3	4						
8	3	3						
9	4	4						
10	1	2						
11	2	3						
12	1	1						
13	2	1						
14	3	2						
15	2	3						
16	1	2						
17	2	2						
18	3	3						
19	2	4						
20	3	3						
21	3	2						
22	1	3						
23	2	2						
24	3	1						
25	2	2						
Total	53	59						
Grand Total	112							
Average	2.24							

Other Observations:

UTILIZATION STUDY -- PAIRED-PLOT METHOD
R2-2200-US

GENERAL DISCUSSION

Forage from protected and unprotected plots is clipped and weighed at the end of the foraging period. The difference represents the amount of forage consumed or trampled by grazing animals during that period. This method is suitable for all vegetative growth forms for which production and utilization data are commonly desired. It is particularly applicable where periods of use are short, utilization relatively uniform, and regrowth after foraging is not significant.

ADVANTAGES AND LIMITATIONS

The method is a simple and direct way of measuring forage utilization. Minor training is required and accuracy is generally high. The chief limitations are that it is time-consuming and that an area must be protected from grazing. There is evidence that in some instances the cage influences the micro climate so that vegetative growth and vigor is slightly different inside the cage. Also, where periods of use are long, the method does not provide information about the cumulative production of grazed plants unless the cages are moved at short time intervals.

TRAINING

The Paired-Plot Method does not require intensive training for field applications. Examiners must be able to identify plant species. Examiners can clip and weigh after only a short training period.

PERSONNEL AND EQUIPMENT

The Paired-Plot Method is time consuming since it requires the construction and placement of cages within the allotment. Appendix F contains diagrams and instructions for constructing several types of cages. Equipment required includes: cages, stakes for securing the cages, hammer for pounding stakes, grass clippers, paper sacks, spring scale (calibrated in grams), and Data Form (R2-2200-US).

SAMPLING PROCEDURE

Locate paired plots within key area(s). Mark the location of the plots so they can be relocated. Document the location of the study on allotment maps and maintain in the 2210 files.

1. Plant composition (species, cover, and growth) must be similar in both plots. Each plot must contain the key species.

2. Clipping the plants has a marked influence on their physiological activities and the ecology of the site. Protected and clipped plots should be moved after use, and new plots selected for continuing study.

NUMBER OF PLOTS

Establish at least three sets of paired plots (three protected and three unprotected) in each key area selected for study. Three plots are a minimum, more should be established as needed.

PROTECTED PLOTS

Protect one plot of each pair from foraging. Flip a coin to decide which plot to protect. Anchor a cage over one of the paired plots at each plot location. The base of a cage should be large enough to provide at least a 6-inch buffer zone between the edge of the plot and the side of the cage. The lower 1-2 feet of the cage may be covered with wire netting small enough to exclude rabbits and rodents. Generally, the larger the mesh, the less influence the cage has in modifying the environment. Cages should be placed just before grazing and never set in a new location the summer or fall before the next growing season. Temporary exclosures, such as those constructed with electric fence, may serve as protected plots instead of cages.

UNPROTECTED PLOTS

Leave one plot of each pair open to foraging. If past experience shows that foraging is particularly uneven, leave two or more plots open for each one caged in order to average the data. Animals are attracted to cages and may trample unprotected plots if located too close to protected plots. Therefore, establish unprotected plots a minimum of 100 feet from protected plots. Unprotected plots should be inconspicuously marked to avoid attracting animals.

SAMPLING

After examiners are trained, proceed with the collection of utilization data.

1. Clip current year's growth on key species from protected and unprotected plots.

2. On herbaceous species, clip all current year's growth to ground level.

3. Put the clippings from the protected and unprotected plots in separate paper sacks for weighing. Be sure to label the sacks.

4. Weigh the sacks of clipped plants and record separately the weight from the protected and unprotected plots on the Utilization Study Data - Paired Plot Method Form (R2-2200-US). Subtract the weight of the sack before recording the weights of the plants.

CALCULATING PERCENT UTILIZATION

Calculate the percent utilization as follows:

$$\%\ \text{Utilization} = \frac{\text{Total Protected Weight} - \text{Total Unprotected Weight}}{\text{Total Protected Weight}} \times 100$$

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UTILIZATION STUDY DATA -- PAIRED PLOT METHOD (R2-2200-US)

Forest	District	Plot ID
BIGHORN NF	**BUFFALO RD**	

Allotment Name and Number	Pasture
TABLE MESA	**BEEF**

Kind/Class & Number of Animals	Period of Use	Actual Use
90 C/C	**8/1 - 8/15**	**45** Animal Months

Date	Examiner(s)
08/17/1994	**J. DAWKINS**

Plot frame			Multiply grams weighed in order to determine:[1] lbs/ac	kg/ha
Rectangle:	20x50 cm.	(.1 m^2)	89.2	100.0
Square:	50x50 cm.	(.25 m^2)	35.7	40.0
Circle:	radius 6.6 in	(0.96 ft^2)[2]	100.0	112.9
Circle:	radius 21.0 in	(9.6 ft^2)[3]	10.0	11.2

Key Species	Plot	Weight in Grams by Plot 1	2	3	4	5	Total Weight[4]	Weight Difference (P-U)	Percent Utilized (((P-U)/P)*100)
1	P[5]	6	8	4	6	3	27		
FEID	U[6]	3	5	4	4	1	17	10	37%
2	P	5	3	4	2	1	15		
STLE4	U	3	1	2	2	1	9	6	40%
3	P	7	6	3	6	5	27		
POPR	U	3	4	2	2	2	13	14	52%
4	P								
	U								
5	P								
	U								
6	P								
	U								
7	P								
	U								
8	P								
	U								
9	P								
	U								
10	P								
	U								

[1] kg/ha x .9 = lbs/ac
[2] The 0.96 ft^2 circle can be constructed by using 41.7in of cable.
[3] The 0 9.6 ft^2 circle can be constructed by using 131.8in of cable.
[4] Minus Weight of the Sack
[5] Protected Plots
[6] Unprotected Plots

Location of Paired Plot 1 **LOBO SPRING**
Location of Paired Plot 2 **PINE MEADOW -- NW**
Location of Paired Plot 3 **TABLE MESA**
Location of Paired Plot 4 **TABLE MESA**
Location of Paired Plot 5 **TABLE MESA**
Notes (use Comments Form, if necessary)

UTILIZATION GAUGE
R2-2200-UG

GENERAL DISCUSSION

This method is essentially the Height/Weight Method used in past range analysis handbooks except that the many pages of standard height/weight curves in past handbooks have been consolidated into a compact gauge that can be easily taken to the field. Utilization curves developed by the Rocky Mountain Forest and Range Experiment Station can be used if they adequately estimate utilization for individual species in your area, or field units can develop their own utilization curves for more localized accuracy.

ADVANTAGES AND LIMITATIONS

This method measures heights of grazed and ungrazed plants in a key area. Large areas can be sampled rather quickly. Limitations occur primarily through using the standard height/weight scales included with the gauge. Standard scales do not accurately reflect utilization in all areas of the Rocky Mountain Region. Users must test their results against paired-plot method results to insure standard scales are accurate for their area. Develop local scales to increase utilization gauge accuracy, but this can be time-consuming.

TRAINING

The utilization gauge does not require intensive training for field application. Examiners must identify plant species and be able to use the gauge. Examiners must also be able to use another utilization method to verify that the results collected from the gauge are accurate and representative of the area. If results are not accurate, the examiner must note the inconsistency and suggest the creation of local utilization scales to use with the gauge.

PERSONNEL AND EQUIPMENT

One person can accomplish this method with: the gauge (Figures 4-2, 4-3, and 4-4) and appropriate species scales, measuring tape, and Data Form (R2-2200-UG).

SAMPLING PROCEDURE

1. At predetermined intervals along a transect or course, select the individual plant of the key species (except seedlings) nearest the toe and measure its height to the nearest 1/2 inch. Measure 100 plants and record each as "Grazed" or "Ungrazed". If necessary, measure additional plants off the transect to insure a minimum of 30 ungrazed plants are included in the sample.

   For seed-stalk-producing (culm) plants, measure tallest seed-stalk to nearest 1 inch; for non seed-stalk-producing (culmless) plants, the tallest leaf heights to 0.50 inch. Of the 100 plants, either measure all leaf lengths or measure all seed stalks. Do not mix leaf length and seed stalk measurements in the same transect.

2. Compute an average "Ungrazed" height by totaling height of all ungrazed plants and dividing by the number of ungrazed plants measured.

3. Compute an average "Grazed" height by totaling the heights of all plants measured on the transect (grazed and ungrazed) and dividing by the total number of plants measured on the transect. The intent is to only use plants measured along the transect for estimating grazed heights. Do not include heights of ungrazed plants off the transect in the calculation.

4. Pull slide out of envelope until scale for species concerned appears in window.

5. Turn dial until average "Ungrazed" height appears opposite arrow so designated.

6. Find "Grazed" heights in #3 on dial and on slide read percent utilization by species.

7. Repeat operation for each key species. Total the utilization percentages for key species and divide by the total number of species to get an overall utilization estimate.

PREPARATION OF UTILIZATION CURVES (SCALES)

Height-weight curves developed for the Rocky Mountain Region were used in developing the utilization scales used in the gauge. If utilization estimates using the gauge do not match clipping measurements, then local utilization curves and scales must be developed. A mechanical process for training, checking personal judgment, and promoting uniformity between examiners, as well as for determining percent utilization follows.

DEVELOPING HEIGHT-WEIGHT CURVES

Develop height-weight curves by collecting plants of a given species and determining the height-weight relationship for that species. The curve for any given species must be checked for variation between different rangeland areas and precipitation zones. It is necessary to develop separate curves for species with both culm-producing and culmless plants.

Sampling Plants

Sample at least thirty plants of each species. Select only plants which have reached maximum growth.

1. At each interval along a paced transect, choose the ungrazed plant of the given species nearest the toe. Use one square inch as a unit area for sod-forming species and a comparable number of stems as a unit area for single stem species.

2. Remove all old leaves and stems of previous year's growth.

3. Clip the plant to within 0.25 inch of the ground.

4. Wrap the clipped plant loosely with thread from base to top to retain all leaves and culms in their natural position.

5. Separate the plants with culms from culmless plants and consider each separately.

6. Measure clipped plants height to the nearest inch and determine average height.

7. Sample additional plants, if necessary.

8. Clip the top 10 percent by height of each plant and place the clippings in a paper bag labeled 0-10 percent. Clip additional height segments in 10 percent increments and place clippings in appropriately labeled bags: 11-20 percent, 21-30 percent, and so on. Use a large paper trimmer with a guide to hold the

plants in their proper position and clip the segments. Label the bags to show species, date, and location. Place a given height segment for all plants of a species collected in one paper bag.

9. Dry the clippings in the paper sacks.

Determining Height-Weight Relationships

1. Weigh and record weights for each segment to the nearest tenth of a gram. Subtract sack weight before recording the dry weights of each height segment.

2. Total the dry weights for the segments. Record the total for the collected plants.

3. Record the cumulative weight for each segment, including the segment weight plus the weights of all preceding segments starting from the top of the plant.

4. Calculate the cumulative percent weight removed at each segment by dividing the cumulative weight for each segment by the total weight and multiplying by 100.

5. Plot the cumulative percent height removed, against the cumulative percent weight removed on graph paper. The resulting curve portrays the height removed-weight removed relationship for the species.

Transferring Data from Curves to Scales

Transfer the height-weight relationship data portrayed on the height-weight curve to a utilization scale for use in the utilization gauge.

1. Turn the dial on the utilization gauge so that 10 inches is at the arrow designated "Average Ungrazed Height." With the dial set at 10, each inch increment from 9 to 0 on the dial represents 10 percent of the height.

2. Slide a blank card into the utilization gauge.

3. Use the height-weight curve to determine the percent height that would be removed when 10 percent, 15 percent, through 95 to 98 percent of the weight is removed.

4. Enter 10 percent, 15 percent through 95 to 98 percent weight removed on the scale in the window of the utilization gauge across from the point on the dial representing the corresponding percent height removed. With the dial set at 10 inches for "Average Ungrazed Height," the percent removed can easily be converted to inches removed.

DOCUMENTING SCALE PREPARATION

Maintain a record for each scale: of species, data used to prepare the scale, date the scale was prepared, and areas of applicability.

Figure 4-2. UTILIZATION GAUGE

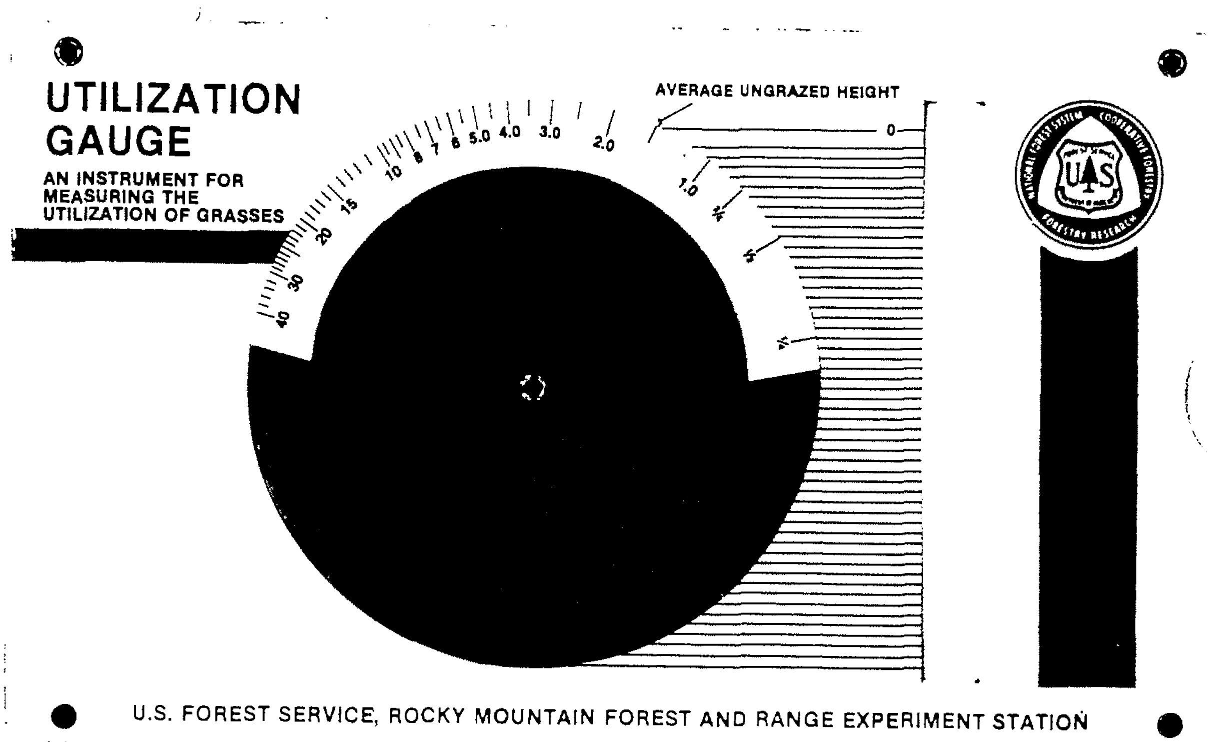
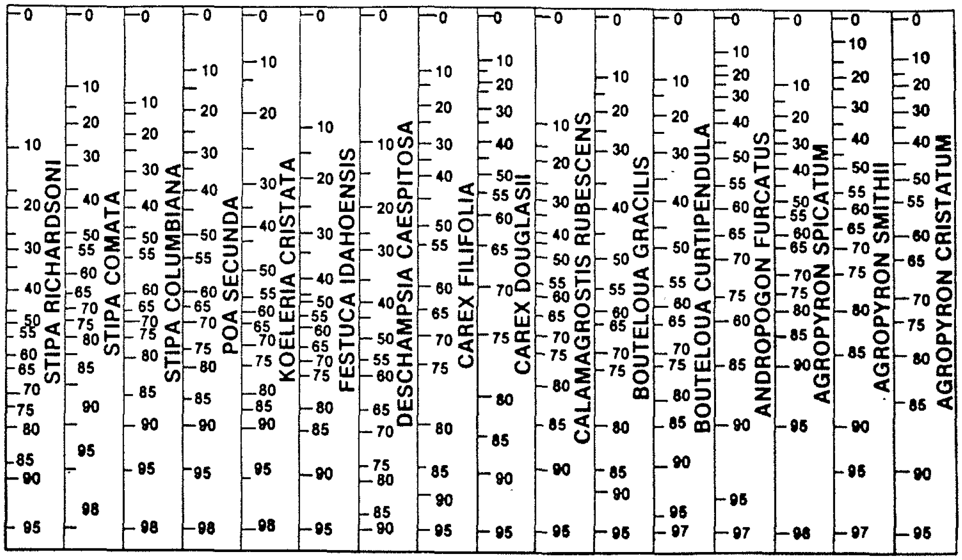


Figure 4-3. SPECIES SCALES (1)



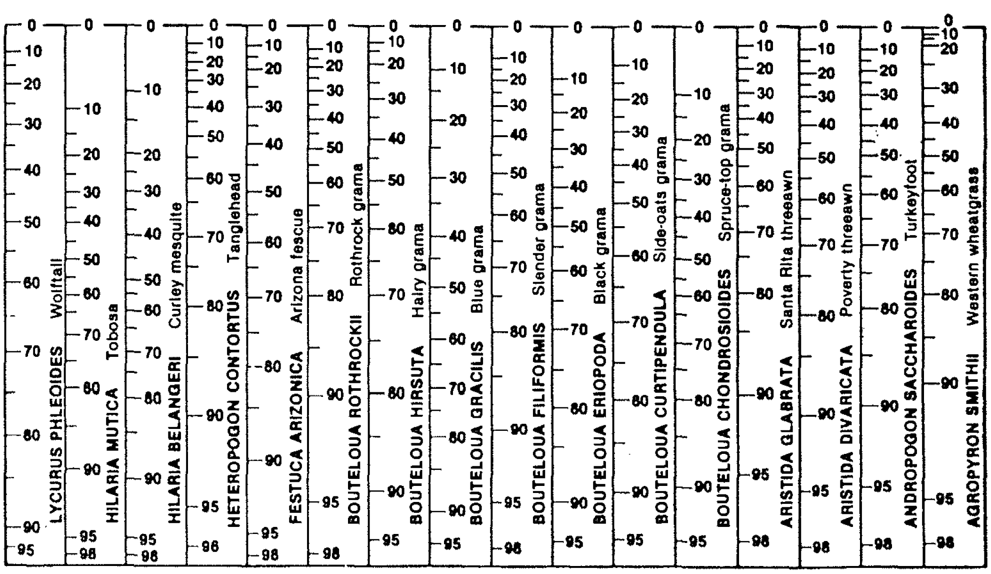
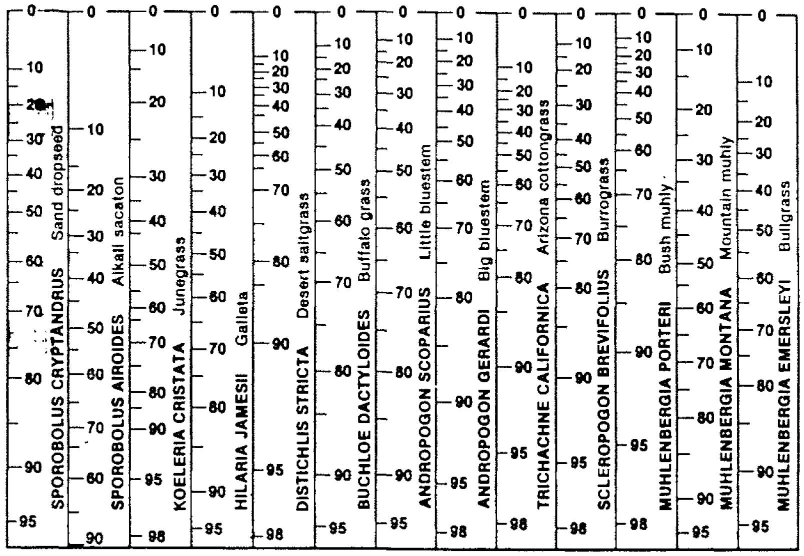
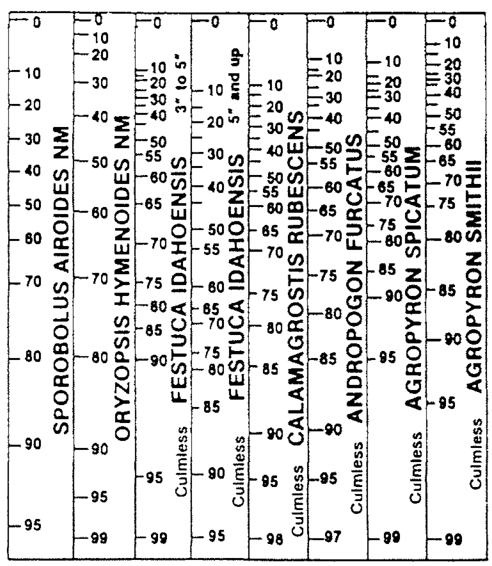


Figure 4-4. SPECIES SCALES (2)





Forest BIGHORN NF	District BUFFALO RD	Plot ID
Allotment Name and Number TABLE MESA		Pasture RED CREEK
Kind/Class & Number of Animals 90 C/C	Period of Use 8/1 - 8/15	Actual Use 45 Animal Months
Date 08/17/1994	Examiner(s) J. DAWKINS	

Key	1. FEID		2. POPR		3.		4.		5.		6.	
Species	G	U	G	U	G	U	G	U	G	U	G	U
1	4	14										
2	3	10										
3	1	9										
4	5	11										
5	2	16										
6	5	12										
7	4	9										
8	2	10										
9	6	10										
10	1	9										
11	5	15										
12	4	14										
13	2	9										
14	1	12										
15	3	8										
16	2	13										
17	1	16										
18	3	11										
19	3	12										
20	3	11										
21	4	14										
22	1	17										
23	5	10										
24	1	8										
25	2	12										
26	2	16										
27	3	13										
28	2	15										
29	1	10										
30	4	13										
31	5											
32	1											
33	3											
34	2											
35	3											
36	4											
37	1											
38	1											
39	2											
40	3											
41	4											
42	5											
43	4											
44	3											
45	3											
46	1											
47	2											
48	2											
49	5											
50	2											

05/07/94

Key Species	1. FEID		2. POPR		3.		4.		5.		6.	
	G	U	G	U	G	U	G	U	G	U	G	U
51	1											
52	1											
53	4											
54	5											
55	1											
56	1											
57	3											
58	3											
59	1											
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93												
94												
95												
96												
97												
98												
99												
100												
Total	186	359										
Ave.[1] Ht.	5.5	12.0										
% Wt.	15%											

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[1] $Ht_{Grazed} = \frac{\sum Grazed + \sum Ungrazed}{100}$ and $Ht_{Ungrazed} = \frac{\sum Ungrazed + \sum Off\ Transect}{n_{Ungrazed} + n_{Off\ Transect}}$

OCULAR ESTIMATE METHODS
R2-2200-OEH, R2-2200-OEB, AND R2-2200-OEA

GENERAL DISCUSSION

The Key Forage Species Method is an ocular estimate of forage utilization of upland herbaceous or browse species within one of six utilization classes. Observations are made on the appearance of the rangeland, especially key species, along a transect which traverses the key area.

ADVANTAGES AND LIMITATIONS

This method is adapted to upland areas where perennial grasses, forbs, and browse plants are the key species and utilization data must be obtained over large areas using few examiners. This method is rapid and does not require ungrazed areas for training purposes. Estimates are based on a description representing a broad range (class) of utilization rather than a precise amount. Different examiners are more likely to estimate utilization in the same classes than they are to estimate the same actual utilization.

TRAINING

Personal judgment is involved in any estimation method. Estimates are only as good as the training and experience of the examiners. Training in the Paired-Plot Method will help examiners make the utilization class estimations. This method requires that the examiners be trained to:

1. Identify the plant species.

2. Recognize the six herbaceous or six browse utilization classes using the written class descriptions.

3. Think in terms of the general appearance of the rangeland (slightly used, heavily used, *etc.*) at each observation point, rather than weight or height removed.

PERSONNEL AND EQUIPMENT

Ocular Estimate Forms (R2-2200-OEH, R2-2200-OEB, and R2-2200-OEA) are required; a tally counter is optional.

SAMPLING PROCEDURE

Select key area(s) and key species and determine the number, length, and location of the transects. Document the location and other pertinent information concerning a transect on the form.

After examiners are trained and have confidence in their ability to judge utilization by utilization class ("light", "heavy", etc.), proceed with the collection of utilization data. At each observation point along the transect, estimate the utilization class using the written description of the class. In those cases where part of a class description does not apply (example: percentage of seed stalks remaining), judge utilization based on those parts of the description that do apply. An observation point is the immediate area containing the key species visible to examiners when standing at a particular location along the transect. Record the estimates by dot count by utilization class on the Ocular Estimate Forms: R2-2200-OEH (Key Herbaceous Species), R2-2200-OEB (Key Browse Species), and R2-2200-OEA (Key Aspen-Weed Community Species).

CALCULATING PERCENT UTILIZATION

Calculate the percent utilization as follows:

1. Convert the dot count to the number of observations for each utilization class.

2. Multiply the number of observations in each utilization class times the midpoints of the class intervals.

3. Total the products for all classes.

4. Divide the sum by the total number of observations on the transect.

5. Record the average percent utilization on the appropriate Ocular Estimate Form (R2-2200-OEH, R2-2200-OEB, or R2-2200-OEA).

HERBACEOUS UTILIZATION CLASSES

Six utilization classes are used to show relative degrees of use of key herbaceous species (grasses and forbs). Each class represents a numerical range of percent utilization. Estimate utilization within one of the six classes. Utilization classes are described as follows:

NO USE (0-5 PERCENT)

The rangeland shows no evidence of grazing use; or the rangeland has the appearance of negligible grazing.

SLIGHT (6-20 PERCENT)

The rangeland has the appearance of very light grazing. The key herbaceous forage plants may be topped or slightly used. Current seed stalks and young plants of key herbaceous species are little disturbed.

LIGHT (21-40 PERCENT)

The rangeland may be topped, skimmed, or grazed in patches. The low value herbaceous plants are ungrazed and 60-80 percent of the number of current seed stalks of key herbaceous plants remain intact. Most young plants are undamaged.

MODERATE (41-60 PERCENT)

The rangeland appears entirely covered as uniformly as natural features and facilities will allow. 15-25 percent of the number of current seed stalks of key herbaceous species remain intact. No more than 10 percent of the number of low value herbaceous forage plants are utilized. (Moderate use does not imply proper use.)

HEAVY (61-80 PERCENT)

The rangeland has the appearance of complete use. Key herbaceous species are almost completely utilized with less than 10 percent of the current seed stalks remaining. Shoots of rhizomatous grasses are missing. More than 10 percent of the number of low value herbaceous forage plants have been utilized.

SEVERE (81-100 PERCENT)

The rangeland has a mown appearance and there are indications of repeated coverage. There is no evidence of reproduction or current seed stalks of key herbaceous species. Key herbaceous forage species are completely utilized. The remaining stubble of preferred grasses is grazed to the soil surface.

BROWSE UTILIZATION CLASSES

Six utilization classes show relative degrees of use of available current year's growth (leaders) of key browse plants (shrubs, half shrubs, woody vines, and trees). Each class represents a numerical range of percent utilization. Estimate utilization within on of the six classes. Utilization classes are described as follows:

NO USE (0-5 PERCENT) Browse plants show no evidence of use; or browse plants have the appearance of negligible use.

SLIGHT (6-20 PERCENT) Browse plants have the appearance of very light use. The available leaders of key browse plants have the appearance of very light use. The available leaders of key browse plants are little disturbed.

LIGHT (21-40 PERCENT) There is obvious evidence of leader use. The available leaders appear cropped or browsed in patches and 60-80 percent of the available leader growth of the key browse plants remains intact.

MODERATE (41-60 PERCENT) Browse plants appear rather uniformly utilized and 40-60 percent of the available leader growth of key browse plants remains intact.

HEAVY (61-80 PERCENT) The use of the browse gives the appearance of complete use. The preferred browse plants are hedged and some plant clumps may be slightly broken. Nearly all available leaders are used and few terminal buds remain on key browse plants. Between 20-40 percent of the available leader growth of the key browse plants remains intact.

SEVERE (81-100 PERCENT) There are indications of repeated coverage. There is no evidence of terminal buds and usually less than 20 percent of available leader growth on the key browse plants remains intact. Some, and often much, of the second and third years' growth of the browse plants has been utilized. Hedging is readily apparent and the browse plants are more frequently broken.

ASPEN-WEED UTILIZATION CLASSES (USED BY SHEEP)

Six utilization classes are used to show relative degrees of use of key species (*Angelica*, *Ligusticum*, *Osmorhiza*, *Phleum*, *Polemonium*, *Trifolium*. and *Vicia*) and impacts to the vegetation (trailing and trampling) as the use occurs in the aspen-weed community. Utilization classes are described as follows:

NO USE (0-5 PERCENT)

The vegetation shows no evidence of grazing use; or the vegetation has the appearance of negligible grazing.

SLIGHT (6-20 PERCENT)

The vegetation has the appearance of very light grazing use. The key species may be topped or slightly used. Current seed stalks and young plants of the key species are little disturbed. There are no readily visible indications of trailing or trampling.

LIGHT (21-40 PERCENT)

The vegetation may be topped, skimmed, or grazed in patches. Plants not considered as key species are ungrazed and 60-80 percent of the number of current seed stalks of the key species remain intact. Most young plants are undamaged. Tall larkspur, aspen peavine, and senecio may be stripped of their leaves, but the stem is still standing. There may be occasional trails through the vegetation, but they are widely scattered. Small scattered patches of vegetation may be knocked down where sheep have bedded or bunched up during the day.

MODERATE (41-60 PERCENT)

The vegetation appears entirely covered as uniformly as natural features and facilities will allow. 15-25 percent of the number of current seed stalks of the key species remain intact. No more than 10 percent of the plants not considered as key species are utilized. Trails through the vegetation are frequently over the entire area and are easily observed. Patches of vegetation that have been knocked down are common throughout the area.

HEAVY (61-80 PERCENT)

The vegetation has the appearance of complete use. Key species are almost completely utilized with less than 10 percent of the current seed stalks remaining. More than 10 percent of the plants not considered as key species have been utilized. Trails overlap and cross each other so as to appear they cover almost the entire area. Sheep scat/dung is very common and readily visible.

SEVERE (81-100 PERCENT)

The vegetation has a mown appearance. There is no evidence of reproduction or current seed stalks of the key species. They are completely utilized. The remaining vegetation is grazed to the soil surface. Trailing damage is extensive and indicated by large areas of soil disturbance/movement.

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UTILIZATION STUDY DATA -- (R2-2200-OEH)
OCULAR ESTIMATE METHOD -- Key Herbaceous Species

Forest	District	Plot ID
BIGHORN NF	BUFFALO RD	

Allotment Name and Number	Pasture
TABLE MESA	RED CREEK

Kind/Class & Number of Animals	Period of Use	Actual Use
90 C/C	8/1 - 8/15	45 Animal Months

Date	Examiner(s)
08/17/1994	J. DAWKINS

Class Interval Midpoint	Spp 1: FEID Dot Count	Total (C)	(CxM)	Spp 2: FETH Dot Count	Total (C)	(CxM)	Herbaceous Utilization Classes (Browse utilization classes are on the other side)
No Use 0-5% M=2.5%		3	7.5		3	7.5	Rangeland shows no evidence of grazing use; or rangeland has appearance of negligible grazing.
Slight 6-20% M=13%		6	78		2	26	Rangeland has appearance of very light grazing. Key herbaceous forage plants may be topped or slightly used. Current seed stalks and young plants of key herbaceous species are little disturbed.
Light 21-40% M=30%		12	360		12	360	Rangeland may be topped, skimmed, or grazed in patches. Low value herbaceous plants are ungrazed and 60-80% of the current seed stalks of key herbaceous species remain intact. Most young plants are undamaged.
Moderate 41-60% M=50%		23	1150		31	1550	Rangeland appears entirely covered as uniformly as natural features and facilities will allow. 15-25% of the current seed stalks of key herbaceous species remain intact. No more than 10% of the low value herbaceous forage plants are utilized. (Moderate use does not imply proper use.)
Heavy 61-80% M=70%		6	420		2	140	Rangeland has appearance of complete use. Key herbaceous species are almost completely utilized with less than 10% of the current seed stalks remaining. Shoots of rhizomatous grasses are missing. More than 10% of the low value herbaceous forage plants have been utilized.
Severe 81-100% M=90%							Rangeland has mown appearance and there are indications of repeated coverage. There is no evidence of reproduction or current seed stalks of key herbaceous species. Key herbaceous forage species are completely utilized. Remaining stubble of preferred grasses is grazed to soil surface.
	Totals	50	2016	Totals	50	2084	

Average Utilization	$\frac{2016}{50} = 40\%$		$\frac{\quad}{\quad} =$	$\frac{\sum C \times M}{\sum C}$

Notes (use Comments Form, if necessary)

UTILIZATION STUDY DATA -- (R2-2200-OEB)
OCULAR ESTIMATE METHOD -- Key Browse Species

Forest	District	Plot ID
BIGHORN NF	BUFFALO RD	

Allotment Name and Number	Pasture
TABLE MESA	RED CREEK

Kind/Class & Number of Animals	Period of Use	Actual Use
90 C/C	8/1 - 8/15	45 Animal Months

Date	Examiner(s)
08/17/1994	J. DAWKINS

Class	Spp 1: AMAL2			Spp 2:			Browse Utilization Classes
Interval Midpoint	Dot Count	Total (C)	(CxM)	Dot Count	Total (C)	(CxM)	(Herbaceous utilization classes are on the other side)
No Use 0-5% M=2.5%		1	2.5				Browse plants show no evidence of use; or browse plants have appearance of negligible use.
Slight 6-20% M=13%		5	65				Browse plants have appearance of very light use. Available leaders of key browse plants have appearance of very light use. Available leaders of key browse plants are little disturbed.
Light 21-40% M=30%		4	120				There is obvious evidence of leader use. Available leaders appear cropped or browsed in patches and 60-80% of available leader growth of key browse plants remains intact.
Moderate 41-60% M=50%		22	1100				Browse plants appear rather uniformly utilized and 40-60% of available leader growth of key browse plants remains intact.
Heavy 61-80% M=70%		18	1260				Browse use gives the appearance of complete use. Preferred browse plants are hedged and some plant clumps may be slightly broken. Nearly all available leaders are used and few terminal buds remain on key browse plants. Between 20-40% of available leader growth of key browse plants remains intact.
Severe 81-100% M=90%							There are indications of repeated coverage. There is no evidence of terminal buds and usually < 20% of available leader growth on key browse plants remains intact. Some, and often much, of the second and third years' growth of browse plants has been utilized. Hedging is readily apparent and browse plants are more frequently broken.
	Totals	50	2548	Totals			
Average Utilization		$\frac{2548}{50} = 51\%$			—— =		$\frac{\sum CxM}{\sum C}$

Notes (use Comments Form, if necessary)

UTILIZATION STUDY DATA -- (R2-2200-OEA)
OCULAR ESTIMATE METHOD -- Aspen-Weed Utilization

Forest	District	Plot ID
WHITE RIVER NF	BLANCO RD	

Allotment Name and Number	Pasture
RIPPLE CREEK	SWAN LAKE

Kind/Class & Number of Animals	Period of Use	Actual Use
100 C/C	7/15 - 8/15	100 Animal Months

Date	Examiner(s)
08/20/1994	B. COLE

Class	Spp 1: Angelica			Spp 2: Osmorhiza			Aspen-Weed Utilization Classes
Interval Midpoint	Dot Count	Total (C)	(CxM)	Dot Count	Total (C)	(CxM)	
No Use 0-5% M=2.5%							The vegetation shows no evidence of grazing use; or the vegetation has the appearance of negligible grazing.
Slight 6-20% M=13%							The vegetation has the appearance of very light grazing use. The key species may be topped or slightly used. Current seed stalks and young plants of the key species are little disturbed. There are no readily visible indications of trailing or trampling.
Light 21-40% M=30%		6	180		2	60	The vegetation may be topped, skimmed, or grazed in patches. Plants not considered as key species are ungrazed and 60-80% of the number of current seed stalks of the key species remain intact. Most young plants are undamaged. Tall larkspur, aspen peavine, and senecio may be stripped of their leaves, but the stem is still standing. There may be occasional trails through the vegetation, but they are widely scattered. Small scattered patches of vegetation may be knocked down where sheep have bedded or bunched up during the day.
Moderate 41-60% M=50%		20	1000		18	900	The vegetation appears entirely covered as uniformly as natural features and facilities will allow. 15-25% of the number of current seed stalks of the key species remain intact. No more than 10% of the plants not considered as key species are utilized. Trails through the vegetation are frequently over the entire area and are easily observed. Patches of vegetation that have been knocked down are common throughout the area.
Heavy 61-80% M=70%		24	1680		30	2100	The vegetation has the appearance of complete use. Key species are almost completely utilized with less than 10% of the current seed stalks remaining. More than 10% of the plants not considered as key species have been utilized. Trails overlap and cross each other so as to appear they cover almost the entire area. Sheep scat/dung is very common and readily visible.
Severe 81-100% M=90%							The vegetation has a mown appearance. There is no evidence of reproduction or current seed stalks of the key species. They are completely utilized. The remaining vegetation is grazed to the soil surface. Trailing damage is extensive and indicated by large areas of soil disturbance/movement.
	Totals	50	2860	Totals	50	3060	
Average Utilization	$\frac{2860}{50} = 57\%$			$\frac{3060}{50} = 61\%$			$\frac{\sum C \times M}{\sum C}$

Notes (use Comments Form, if necessary)

COVER-FREQUENCY TRANSECT METHOD
R2-2200-CF

GENERAL DISCUSSION

Since the Cover-Frequency Transect Method is the standard method for rangeland inventory, it will also be the standard for monitoring changes in canopy cover and frequency of herbaceous species. This method provides estimates of canopy cover by species, frequency, ground cover, and production by life form through replicated sampling of plot frame transects. This method is applicable to a wide variety of plant communities as long as the plants do not exceed waist height.

ADVANTAGES AND LIMITATIONS

This method is relatively simple and rapid to use. Canopy cover and frequency is widely used in vegetation classification throughout the western United States. With adequate training, repeatable results are usually obtained. A limitation of this method is that there can be changes in canopy cover of herbaceous species between years because of climatic conditions with no relationship to the effects of management.

Combining canopy cover and frequency helps overcome data variability due to climate. A cover-frequency index (cover x frequency by species) can be used to determine change in composition over time. When using the cover-frequency method for monitoring purposes, establish a minimum of three transects on the site.

SAMPLING PROCEDURES

A complete description, equipment needs, and instructions for the Cover-Frequency Transect Method can be found in the Inventory Chapter (page 3-57).

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LINE INTERCEPT
R2-2200-LI

GENERAL DISCUSSION

The Line Intercept Method consists of horizontal, linear measurements of plant intercepts along the course of a line (tape). It will be used primarily for quantitative measurements of shrub canopy cover, and may be used to calibrate ocular estimates of shrub canopy cover. This method is ideally suited for semiarid bunchgrass-shrub or riparian-shrub communities. Changes in canopy cover of sagebrush, snowberry, serviceberry, or other shrubs are easily determined using this method.

ADVANTAGES AND LIMITATIONS

Line Intercept is a fast, easy, and accurate method of monitoring canopy cover changes of shrub species. It is best suited where the plant limits are well defined. It is not well adapted, however, for single stemmed species, dense grassland situations, litter, or rock less then 1/2 inch in diameter.

SAMPLING PROCEDURE

A complete description, equipment needs, and instructions for Line Intercept can be found in the Inventory Chapter (page 3-73).

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ROOTED NESTED FREQUENCY
R2-2200-RN

GENERAL DISCUSSION

For monitoring trend, the Rooted Nested Frequency Method analyzes changes in frequency of individual species over time on a specific site. Desired plant communities are selected and documented during allotment management planning. Increases or decreases in frequency of the species within the plant community can be estimated with the Rooted Nested Frequency Method.

An increase in a species that is dominant in the desired plant community can be interpreted as desirable or trending "toward" the desired plant community (DPC), and a decrease in a dominant species can be considered trending "away from" DPC.

ADVANTAGES AND LIMITATIONS

Frequency sampling is an objective method that is simple to perform and easy to duplicate from year to year. The only decisions to be made are plant species identification, and whether or not the listed species occurs within the plot. This method encourages consistent, accurate observations while minimizing bias among different examiners. Rooted Nested Frequency is the most reliable method for determining long-term trend, but is probably the most time consuming.

Frequency data is collected in different sized plots with each placement of the nested frame. When a plant occurs within a plot, it also occurs in all successively larger plots. Frequency of occurrence for various sized plots can be analyzed, although frequency is recorded for only one size plot. This eliminates problems with comparing frequency data from different sized plots. Use of the nested plot configuration improves the chance of selecting a proper plot size for frequency sampling. Frequency data is not subject to substantial fluctuations with climate. ***This method should only be used when the highest level analysis intensity (see Table 3-1, page 3-4) is required.***

Frequency determinations give a good indication of changes in the occurrence of individual species over time. Frequency does not, however, provide a good description of the vegetative characteristics of a plant community, or why the vegetation is changing. Characteristics like cover, density, and spatial

arrangement cannot be determined through frequency measures. A combination of the Cover-Frequency Method and the Rooted Nested Frequency Method will best describe changes in the vegetation and soil components of a plant community.

PERSONNEL AND EQUIPMENT

Two examiners are required for rooted nested frequency method. It is best if one person does the observations and the other records them. Two 100-foot tapes are required: one for the baseline and the other to be moved from transect position to transect position. A rooted nested frequency frame, and a die for randomly determining the sampling scheme are required. Other equipment is the same as for cover-frequency transects (page 3-57).

SAMPLING PROCEDURE

Upon selecting the study site and/or finding the previously established benchmark, the location should be documented and any changes in reference points or status of the transect noted.

PHOTOGRAPHS

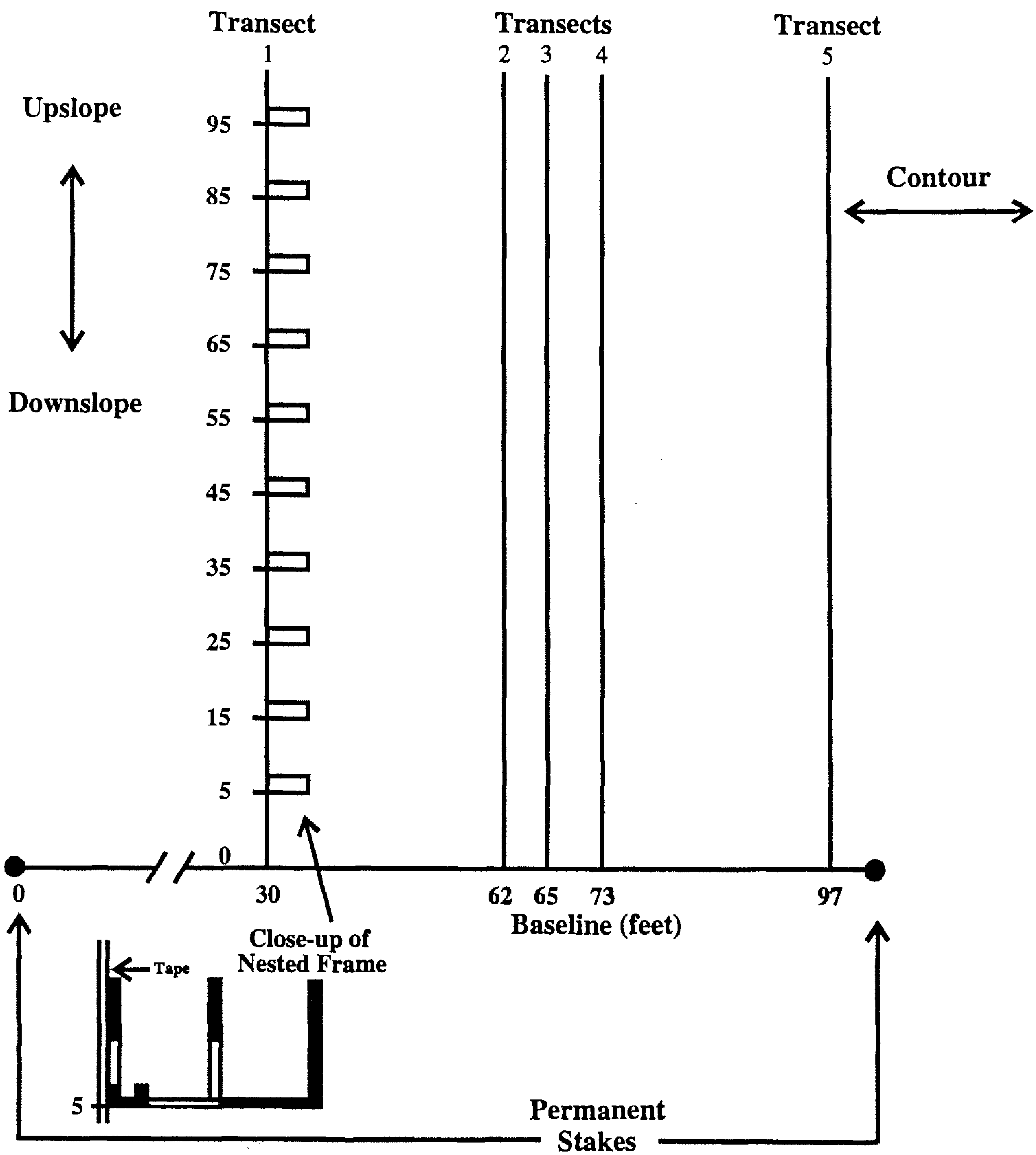
Photographs are an important part of the study and should portray changes taking place on the ground. They should provide a good visual image of the site and help relocate the study for future measurements.

As a minimum, a general view and a close-up photo of the 3 foot by 3 foot plot should be taken before taking any measurements. Photos should be taken from the 0.0 mark on transect 1 or at the best suitable point. Additional photos are encouraged.

SAMPLE DESIGN

The typical plot sampled in the Rooted Nested Frequency method is a square measuring 100 x 100 feet. In some cases, due to a mosaic of vegetation types, this shape may be changed to insure uniformity in the sampled vegetation community. The typical baseline for the transects is 100 feet long and is located perpendicular to the slope (on the slope contour) with the 0-foot mark on the left and the 100-foot mark on the right as the examiner faces upslope. Transects are placed perpendicular to the baseline (that is, parallel with the slope) and are sampled starting at the baseline (Figure 4-5). The baseline runs from west to east on flat areas with the 0-foot mark on the west end and the 100-foot mark on the east end. On flat areas, transects are located from the baseline to the north.

Figure 4-5. ROOTED NESTED FREQUENCY TRANSECT LAYOUT



Take close-up photo of 3' x 3' carpenter rule plot centered on 5' mark of first transect.

ESTABLISHING TRANSECTS

Locate transects within the plot perpendicular to the baseline and parallel with the slope. Since all rooted nested frequency plots are permanent, determine compass bearings of transects, and install angle iron or re-bar stakes at the transect starting points on the baseline. Five transects will be adequate for most sampling needs; however up to seven transects may be sampled if the variation requires it.

Starting locations of transects are determined by selecting the sampling scheme from Table 4-3. Use the roll of one six-sided die to determine which scheme to use. This determination can be done before leaving the office; that guarantees an unbiased selection, and it may keep the die from getting lost. This table represents randomly generated sampling schemes for placement of 5-7 transects along the 100-foot baseline.

Do not use the same sampling scheme for every plot. This will avoid transects being placed in the same location along the baseline and creating a biased sampling system. Figure 4-5 depicts transect locations along a baseline using sampling scheme number 1.

Table 4-3. ROOTED NESTED FREQUENCY SAMPLING SCHEMES

Sample Scheme	Distance along Baseline (feet)[6]						
1	30	57	62	65	73	83	97
2	40	41	59	68	75	78	92
3	18	28	50	58	68	82	92
4	3	7	26	62	66	80	84
5	9	24	26	33	78	86	92
6	6	26	37	60	74	77	84

COVER-FREQUENCY TRANSECT

At least one cover-frequency transect should be done in conjunction with the rooted nested frequency transect. It is probably best to do the cover-frequency on the first rooted nested frequency transect.

[6] Shaded numbers are for additional transects that will only be used when seven transects are needed.

NUMBER OF TRANSECTS

Begin this method by laying out and recording plant species data on five transects. To determine if five transects are adequate, calculate the cumulative number of new species, absolute number of new species, and the percent increase in new species for each transect. If the percent increase in new species recorded through the fifth transect is less than 25 percent for two consecutive transects, only five transects are required. If this condition is not met, seven transects are required.

An example demonstrating when five transects are adequate is shown in Table 4-4. Although this example shows a less than 25 percent increase for transects 3 and 4, there will *always* be at least five transects established for every rooted nested frequency plot.

Table 4-4. DEMONSTRATION OF SAMPLING ADEQUACY

Transect Number	Cumulative Number of New Species	Absolute Number of New Species	Percent Increase in New Species
1	14	14	100
2	20	6	30
3	23	3	13
4	24	1	4
5	24	0	0

NUMBER OF SAMPLES (FRAMES)

A minimum of 50 frames shall be sampled at each study site. Ten frames shall be measured along each of the transects at each 10-foot mark with the frame on the right side of the transect facing the 100-foot end. The small 5 cm x 5 cm plot should lie next to the beltline.

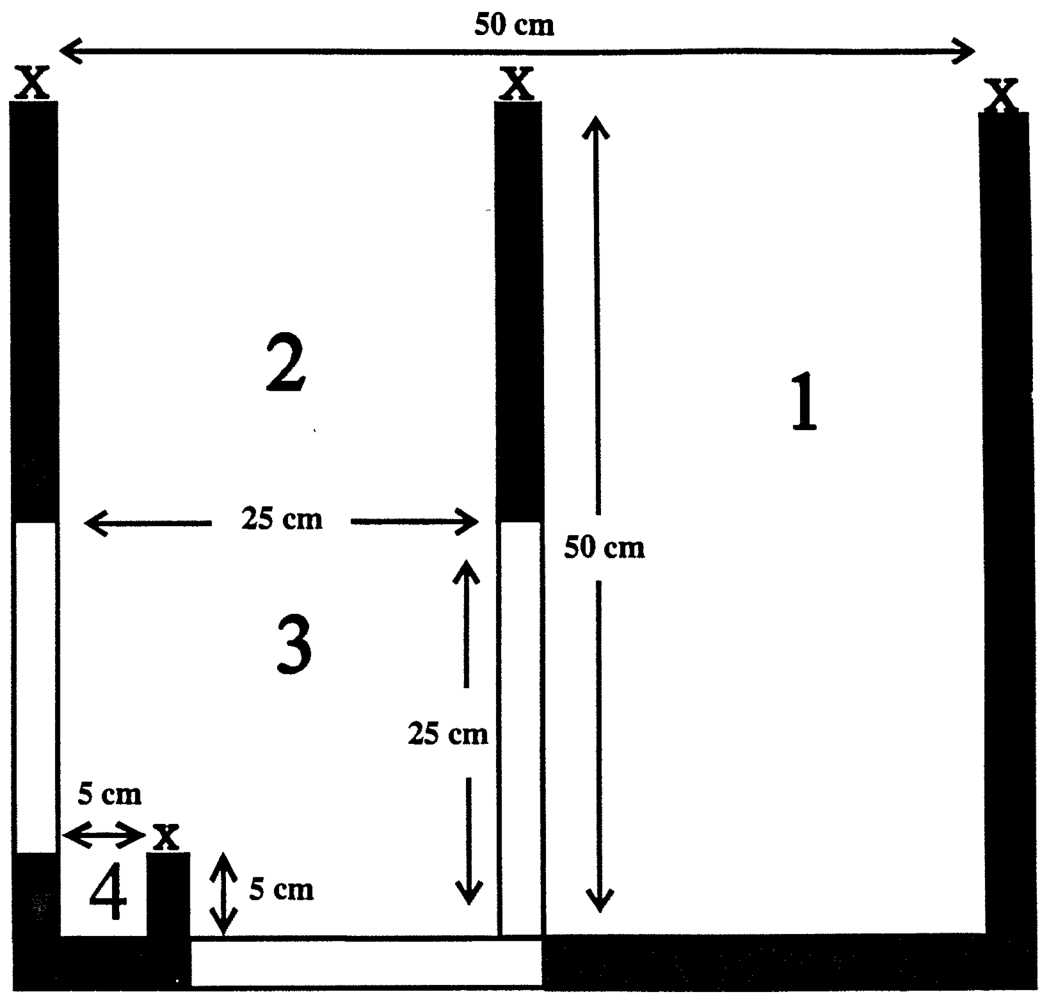
ROOTED NESTED FREQUENCY PLOT SIZE

The nested plot(s) in a frame refer to the size of the sampling units contained (nested) within the frame. Sampling of the vegetation is done with four plots of different sizes where the smaller plots are contained (nested) within a larger plot. The standard rooted nested frame for the Rocky Mountain Region is 50 x 50 cm. Plot size dimensions contained within that frame are in Table 4-5. Figure 4-6 illustrates the frequency frame.

Table 4-5. NESTED PLOT SIZES

Plot Number	Nested Plot Size
1	50 x 50 cm
2	25 x 50 cm
3	25 x 25 cm
4	5 x 5 cm

Figure 4-6. ROOTED NESTED FREQUENCY FRAME



Nested frequency frame is constructed from 0.5 inch PVC pipe. All dimensions are inside measurements. The "x" at the end of all four legs are the locations for ground cover measurements.

NUMERICAL IDENTIFICATION OF NESTED PLOTS

Since data is collected from all four plots within the frequency frame, individual plots within the frame need to be easily identified. The concept of nested plots can be best described as follows:

If Kentucky bluegrass is encountered in plot #4, it is automatically encountered in plots #1, #2, and #3 as well. This is true because plot #4 is a physical subset of all the other plots.

However, if the smallest plot Thurber fescue is found in is plot #2, then it is also in the larger plot (#1), but not in plots #3 and #4.

It is also important to understand that in this example, Kentucky blue grass (#4) does not occur twice as frequently as Thurber fescue (#2). The plot codes do not convey relative size. Conclusions from rooted nested frequency data can only be derived after the plot is resampled at a later time. Then the change in frequency *by an individual species* within the time interval between measurements can be determined.

PLACEMENT OF THE FRAME

Once a transect has been set up, the frame should be placed at the specified intervals along the transect.

The frame should be positioned so the open end of the frame is pointed towards the 100 foot end of the tape with the small plot (plot #4) next to the tape. Once the frame is placed on the footmark, it should not be moved during sampling to include or exclude species. Placing the frame at the specified interval assures that samples are well distributed along the transects and avoids personal bias. This procedure should be followed until data have been collected from 10 frames along each of the five transects.

PRESENCE OR ABSENCE MEASUREMENTS

Only species rooted within the frame will be recorded. No effort will be made to count the number of individual plants. A plant is considered rooted within the plot/frame if any portion of the root crown is contained therein. In case of mat-forming species, any portion of the crown extending into the plot will constitute presence of that plant. Reading and recording will be as follows:

1. Determine the presence of all species contained within plot 4 (the smallest nested plot). Record their presence on the Nested Frequency Data form by placing a number 4 in the block for that particular sample along the transect.

2. Determine the presence of any additional species in the next larger plot. Enter a number 3 for these species. Record a 3 only for species not encountered in the smaller plot (plot 4).

3. Determine the presence of any additional species in the third largest plot (plot 2). Enter a number 2 for those additional species encountered.

4. Record the presence of any other species in the largest plot (plot 1); place a number 1 only if additional species are encountered.

5. Record a blank or dash line on the form if the species of concern is missing on all plots for a particular frame.

6. The field portion of the form (R2-2200-RN) should be completed before proceeding to the next transect. This includes summarizing ground cover, and listing species missed in sampling.

7. In rereading monitoring areas that have special or limited objectives tied to 4 or 5 indicator species, the monitoring design could be limited to rereading only those species that are delineated for monitoring in the plan. Statistical analysis can be used on individual species for individual species trend determinations.

COMPUTATION OF FREQUENCY

Frequency is defined as the sum of the numbered plots for the ten nested plots along a sample transect. For example, the frequency for *Agropyron trachycaulum* along the following transect is 21:

Frame	1	2	3	4	5	6	7	8	9	10	Total
AGTR	1	3	2	4	2	2	2	1	2	2	21

This example only shows one transect. Frequency will be determined using all 50 frames (200 sample plots) on all five transects.

Data from all plots shall be used because change can be detected quicker using a rooted nested frequency plot (200 samples on five transects) rather than a single plot (50 samples on five transects).

SPECIES FOUND BUT NOT ENCOUNTERED IN PLOTS

Any species not encountered in the individual plots but found growing along the transect should be listed at the bottom of the data sheet. These species, although not abundant, may be indicative of the management emphasis needed or be a key indicator species.

NESTED FREQUENCY DATA SUMMARY

Data collected from all five transects shall be summarized on R2-2200-RNSum.

GROUND COVER SAMPLE MEASUREMENT

Ground cover measurements can be easily obtained when reading Rooted Nested Frequency transects. Record cover and bare soil data by noting the type of ground cover component present at the locations on the frequency frame shown in Figure 4-6. Take 4 ground cover measurements on each frame to yield 200 samples for the plot (4 samples/frame x 10 frames/transect x 5 transects = 200 samples/plot). Use a dot tally recording system to keep track of this information.

FORM DESCRIPTION
R2-2200-RN

The Rooted Nested Frequency Data Form (R2-2200-RN) accommodates up to 45 items and 10 plot frames per transect. If there are more than 45 species on the transect, use additional field sheets as appropriate (that is, the data base can accommodate as many species as are present on up to 7 transects).

A summary data form is provided which is used for data entry (that is, information by species is entered by transect and not by individual plot frame).

FIELDS 1-7: RECORD IDENTIFIER (15-CHAR)

Enter the Key ID identified in fields 1-7 of the General Field Data Form (R2-2200-GF).

Required.
Accuracy Standards = No Errors.

FIELD 8: PLANT IDENTIFICATION LEVEL (2-CHAR)

Identify the sampling type conducted in the first column (Code 1). Identify whether all plants or only selected plant species, genera, or life forms encountered in plots are measured (Code 2).

CODE 1	SAMPLING TYPE
C	Only cover/frequency data are being collected
N	Only rooted nested frequency data are being collected
B	Both types of data are being collected

CODE 2	SPECIES IDENTIFICATION LEVEL
A	All plants encountered are being measured to species, genera, or life form
S	Selected species, genera, or life forms are being measured

NOTE: This field cannot be left blank during data entry.

Required.
Accuracy Standards = No Errors.

FIELD 9: TRANSECT NUMBER (2-NUM)

Identify which transect this form is by identifying transect number "x" of "y" where "x" is the transect number and "y" is the total number of transects in the sample, usually five or seven. This number cannot exceed 10.

Required.
Accuracy Standards = No Errors.

FIELD 10: TRANSECT LENGTH (3-NUM)

Enter the total length of the transect. The standard length for the Rocky Mountain Region is 100 feet.

Required.
Accuracy Standards = No Errors.

FIELD 11: NUMBER OF FRAMES PER TRANSECT (2-NUM)

Enter the number of plot frames used to record rooted nested frequency along the transect. The standard number of plot frames for the Rocky Mountain Region is 10. More than 10 may be used if the variability if the site or other reasons warrant. No fewer than 10 plot frames will be established per transect.

Required.
Accuracy Standards = No Errors.

FIELD 12: ROOTED NESTED FREQUENCY RATIO (1-CHAR)

Four nested microplots will be used for rooted nested frequency assessment. The size ratio used in the Rocky Mountain Region is 100:50:25:1 (see Figure 4-6). Enter a "2" in this field to indicate that size ratio.

Required.
Accuracy Standards = No Errors.

FIELD 13: LIFE FORM (1-CHAR)

Enter one of the following codes to describe the correct life form for each plant species, genus, or life form being sampled.

CODE	LIFE FORM
T	tree (includes conifer and broadleaf trees)
S	shrub (includes woody stemmed vines and subshrubs)
G	graminoid
F	forb
E	fern/allies (includes *Lycopodium* and *Selaginella*)
M	moss
L	lichen
U	fungus
A	alga
Z	not applicable

Required, for plant species.
Accuracy Standards = No Errors.

> *NOTE: Whenever a plant species code (or symbol) is required, use the 8-character alpha-numeric codes from the standard Soil Conservation Service's PLANTS data base. Lists of all species by state are available from the Forest botanist, ecologist, or soil scientist.*

FIELD 14: ITEM NAME (8-CHAR)

The data base can accommodate all items sampled on as many as 10 transects, even though the field form only allows 45 entries per page. Use as many pages of R2-2200-RN as needed to record all items of interest in sampling.

Required.
Accuracy Standards = No error in species level identification for dominant, common, or habitat type indicator plants.

ROOTED NESTED FREQUENCY (1-NUM)

Rooted nested frequency may be recorded, by plant species, in each plot frame using the following procedure:

1. Indicate the smallest subplot each plant species is rooted in.

2. Record "4" if the basal portion of a plant species is rooted in the smallest subplot.

3. Record "3" if the basal portion of a plant species is rooted in the next largest subplot ***and is not previously recorded in subplot 4.***

4. Record "2" if the basal portion of a plant species is rooted in the next largest subplot ***and is not previously recorded in subplots 3 or 4.***

5. Record "1" if the basal portion of a plant species is rooted in the largest subplot ***and is not previously recorded in subplots 2, 3, or 4.***

Individual plot frame rooted nested frequency values are not entered in the data base. They are summed by transect for a given plant species and entered in Field 15.

Required, if rooted nested frequency is measured.
Accuracy Standards = No Errors.

FIELD 15: SUM OF ROOTED FREQUENCY (SRF) (2-NUM)

Enter (by item) the sum of the rooted nested frequency values for the transect. This value is calculated by adding the subplot numbers recorded for a given plant species over all plot frames sampled within a transect. The maximum value for a plant species on a transect occurs when all the plot frames have the species in the smallest subplot (that is, summed value = 4 x number of microplots sampled).

Required, if rooted nested frequency is measured.
Accuracy Standards = No Errors.

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ROOTED NESTED FREQUENCY DATA
(R2-2200-RN)

F1-7: **F S -- 0 2 -- 0 4 -- 0 9 -- 9 4 -- M B -- 0 8 2**

Plot ID Agency Region Forest District Year Exam'r Plot Number

F8 Plant ID C A   F9 Tran: 1 of 5   F10 Tran Len: 1 0 0   F11 Fr/Tran: 1 0   F12 RN Ratio: 2

	F13	F14	Rooted Nested Frequency										F15
	LF	Item	1	2	3	4	5	6	7	8	9	10	SRF
1	S	ARTRV			2				1			4	7
2	S	SYOR2											
3	S	CHVI8		3									3
4	G	FETH	2	1			3			4		1	11
5	G	CAEL3		2		1	2		1		2		8
6	G	POPR	4	3	1	4	4	2	3	3		1	25
7	G	PONE2	2		1		3	4		2			12
8	G	KOMA	1			2			3				6
9	G	KOCR			3		1				2		6
10	G	BROMU						3					3
11	F	ACLA5	4		2	2	3		2	2	3	1	19
12	F	TAOF		2	2		2	2		1	3	4	16
13	F	PHMU3		4		4		2	2	3		1	16
14	F	MEFU2				1				1			2
15	F	LATHY						2					2
Req	Z	WOOD											
Req	Z	LITTER/DUFF	2	1	4	2	1	2	4		1	2	19
Req	Z	MOSS/LICHEN				1							1
Req	Z	BASAL VEG	1					2			3	1	7
Req	Z	WATER											
Req	Z	BARE SOIL <2mm	1	3		1	2			4		1	12
Req	Z	GRAVEL 2mm-3in					1						1
Req	Z	COBBLE 3-10in											
Req	Z	STONE 10-24in											
Req	Z	BOULDER >24in											
Req	Z	BEDROCK											

ROOTED NESTED FREQUENCY DATA (RN)

F1-7: F S -- 0 2 -- 0 4 -- 0 9 -- 9 4 -- M B -- 0 8 2

Plot ID Agency Region Forest District Year Exam'r Plot Number

	F13	F14	Rooted Nested Frequency										F15
	LF	Item	1	2	3	4	5	6	7	8	9	10	SRF
16	F	ERIOG						2					2
17	F	DEBA2									1		1
18	F	GASE6											
19	F	NOMO2			2			4					6
20													
21													
22													
23													
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45													

FORM DESCRIPTION R2-2200-RNSUM

The Rooted Nested Frequency Summary Form (R2-2200-RNSum) accommodates up to 45 items. If there are more than 45 species on the transect, use additional field sheets as appropriate (that is, the data base can accommodate as many species as are present on up to 7 transects).

FIELDS 1-7: RECORD IDENTIFIER (15-CHAR)

Enter the Key ID identified in Fields 1-7 of the General Field Data Form (R2-2200-GF).

Required.
Accuracy Standards = No Errors.

FIELD 8: PLANT IDENTIFICATION LEVEL (2-CHAR)

Identify the sampling type conducted in the first column (Code 1). Identify whether all plants or only selected plant species, genera, or life forms encountered in plots are measured (Code 2).

CODE 1	SAMPLING TYPE
C	Only cover/frequency data are being collected
N	Only rooted nested frequency data are being collected
B	Both types of data are being collected

CODE 2	SPECIES IDENTIFICATION LEVEL
A	All plants encountered are being measured to species, genera, or life form
S	Selected species, genera, or life forms are being measured

NOTE: This field cannot be left blank during data entry.

Required.
Accuracy Standards = No Errors.

FIELD 9: NUMBER OF TRANSECTS (2-NUM)

Identify the total number of rooted nested frequency transects taken on this sample. The total number of transects in the sample is usually 5 and sometimes as many as seven.

Required.
Accuracy Standards = No Errors.

FIELD 10: TRANSECT LENGTH (3-NUM)

Enter the total length of the transect. The standard length for the Rocky Mountain Region is 100 feet.

Required.
Accuracy Standards = No Errors.

FIELD 11: NUMBER OF FRAMES PER TRANSECT (2-NUM)

Enter the number of plot frames used to record rooted nested frequency along the transect. The standard number of plot frames for the Rocky Mountain Region is 10. More than 10 may be used if the variability if the site or other reasons warrant. No fewer than 10 plot frames will be established per transect.

Required.
Accuracy Standards = No Errors.

FIELD 12: ROOTED NESTED FREQUENCY RATIO (1-CHAR)

Four nested microplots will be used for rooted nested frequency assessment. The size ratio used in the Rocky Mountain Region is 100:50:25:1 (see Figure 4-6). Enter a "2" in this field to indicate that size ratio.

Required.
Accuracy Standards = No Errors.

FIELD 13: LIFE FORM (1-CHAR)

Enter one of the following codes to describe the correct life form for each plant species, genus, or life form being sampled.

CODE	LIFE FORM
T	tree (includes conifer and broadleaf trees)
S	shrub (includes woody stemmed vines and subshrubs)
G	graminoid
F	forb
E	fern/allies (includes *Lycopodium* and *Selaginella*)
M	moss
L	lichen
U	fungus
A	alga
Z	not applicable

Required, for plant species.
Accuracy Standards = No Errors.

> *NOTE: Whenever a plant species code (or symbol) is required, use the 8-character alpha-numeric codes from the standard Soil Conservation Service's PLANTS data base. Lists of all species by state are available from the Forest botanist, ecologist, or soil scientist.*

FIELD 14: ITEM NAME (8-CHAR)

The data base can accommodate all items sampled on as many as 10 transects, even though the field form only allows 45 entries per page. Use as many pages of R2-2200-RN as needed to record all items of interest in sampling.

Required.
Accuracy Standards = No error in species level identification for dominant, common, or habitat type indicator plants.

SUM OF ROOTED FREQUENCY (SRF) (2-NUM)

Enter (by item) the sum of the rooted nested frequency values for each transect. This value is calculated by adding the subplot numbers recorded for a given plant species over all plot frames sampled within a transect. The maximum value for a plant species on a transect occurs when all the plot frames have the species in the smallest subplot (that is, summed value = 4 x number of microplots sampled).

Required, if rooted nested frequency is measured.
Accuracy Standards = No Errors.

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ROOTED NESTED FREQUENCY SUMMARY
(R2-2200-RNSum)

F1-7: **F S -- 0 2 -- 0 4 -- 0 9 -- 9 4 -- M B -- 0 8 2**

Plot ID Agency Region Forest District Year Exam'r Plot Number

F8 Plant ID C A   F9 Transect: __5   F10 Transect Length: 1 0 0   F11 Frames/Transect 1 0   F12 RN Ratio 2

	F13	F14	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6	Transect 7
	LF	Item	SRF	SRF	SRF	SRF	SRF	SRF	SRF
1	S	ARTRV	7	10	5	4	12		
2	S	SYOR2		3		2			
3	S	CHVI8	3		2	6	8		
4	G	FETH	11	4	1				
5	G	CAEL3	8	2	3	14	6		
6	G	POPR	25	12	19	12	18		
7	G	PONE2	12	5	14	12	6		
8	G	KOMA	6		4		1		
9	G	KOCR	6		1	7			
10	G	BROMU	3	5	6	1			
11	F	ACLA5	19	24	16	26	14		
12	F	TAOF	16	8	12	20	18		
13	F	PHMU3	16	4	1		6		
14	F	MEFU2	2	1		2			
15	F	LATHY	2		1		5		
Req	Z	WOOD							
Req	Z	LITTER/DUFF	19	20	12	22	14		
Req	Z	MOSS/LICHEN	1		3				
Req	Z	BASAL VEG	7	10	5	4	8		
Req	Z	WATER					2		
Req	Z	BARE SOIL	12	10	16	14	14		
Req	Z	GRAVEL	1				2		
Req	Z	COBBLE			4				
Req	Z	STONE							
Req	Z	BOULDER							
Req	Z	BEDROCK							

ROOTED NESTED FREQUENCY SUMMARY
(R2-2200-RNSum)

F1-7: F S -- 0 2 -- 0 4 -- 0 9 -- 9 4 -- M B -- 0 8 2

Plot ID Agency Region Forest District Year Exam'r Plot Number

	F13	F14	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6	Transect 7
	LF	Item	SRF	SRF	SRF	SRF	SRF	SRF	SRF
16	F	ERIOG	2			1			
17	F	DEBA2	1				4		
18	F	GASE6		4		3			
19	F	NOMO2	6				1		
20	F	ASDR3		1	1				
21	F	LUAR3		2	3	2			
22									
23									
24									
25									
26									
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SHRUB DENSITY AND AGE/FORM CLASS
R2-2200-SD

GENERAL DISCUSSION

Shrub density data can be used to supplement data collected with other trend monitoring methods, or be used by itself depending on the monitoring goals and objectives. It should not be employed as the sole basis for determining trend but may be used with or in lieu of the line intercept procedure. The technique provides plant (shrub) species density along with information on the form and age class of the various shrubs present. This information provides additional data for evaluating condition or trend in the shrub community, and is especially important where some form of cultural treatment has been done and/or where the shrub component is important.

SAMPLING PROCEDURE

Measurements for this procedure can be taken in conjunction with other trend transects. Measurements are taken along the whole 100-foot transect creating a sample area 100 feet long and 3 feet wide. A similar type study area can be independently set up if measurements are not made in conjunction with frequency belts.

All shrubs (or measured plants) encountered along the transect are dot tallied by species and classified according to form and age class. The Shrub Density Data Form (R2-2200-SD) is used to record this information. See page 3-87 for a more detailed description of this method.

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PRODUCTION-UTILIZATION SURVEYS
R2-2200-PU

GENERAL DISCUSSION

Production-Utilization surveys require the completion of these steps:

1. Estimate production and utilization within a pasture or allotment. Use patterns or use zones are delineated on a map. Average utilization (expressed as a percentage of current growth), and production (in pounds of forage per acre) will be recorded for each use zone. Of the several methods of estimating production and utilization, ocular estimates verified through clipping and weighing is generally the most practical (see page 4-35).

   Utilization estimates should be taken soon after livestock are removed from the area. For multi-pasture allotments the observer will need to make measurements after livestock are removed from each pasture. Acres should be calculated for each use zone and recorded.

2. Allowable use estimates should be made for each use zone identified. Allowable use is expressed as a percentage of current year's growth, and is determined primarily from allowable use guidelines documented in the Forest Plan or AMP. Allowable use varies between use zones based on: location of the zone (riparian *vs.* upland site), time of use (early *vs.* late use pasture), management system in place, and distance from water. Allowable use should also be based on past distribution of grazing use.

   As an example, an allowable use of 45 percent should not be established for a use zone when past utilization measurements indicate that the zone rarely gets utilized more then 15 percent. If improved management could increase use in a particular zone, the allowable use estimate should reflect this expected increased use.

3. Transfer the recorded information to the allotment map as follows:

$$\frac{\text{\% actual use -- lbs. production/acre -- \% allowable use}}{\text{Acres in use zone}}$$

Figure 4-7 shows an example of a completed use zone map with recorded information.

4. Complete the Production-Utilization Summary Form (R2-2200-PUSum) for each pasture or unit. This involves calculating the Actual Area Use Factor and the Allowable Area Use Factor:

$$\text{Acres} \times \text{Actual Use \%} = \text{Actual Area Use Factor}$$

$$\text{Acres} \times \text{Allowable Use \%} = \text{Allowable Area Use Factor}$$

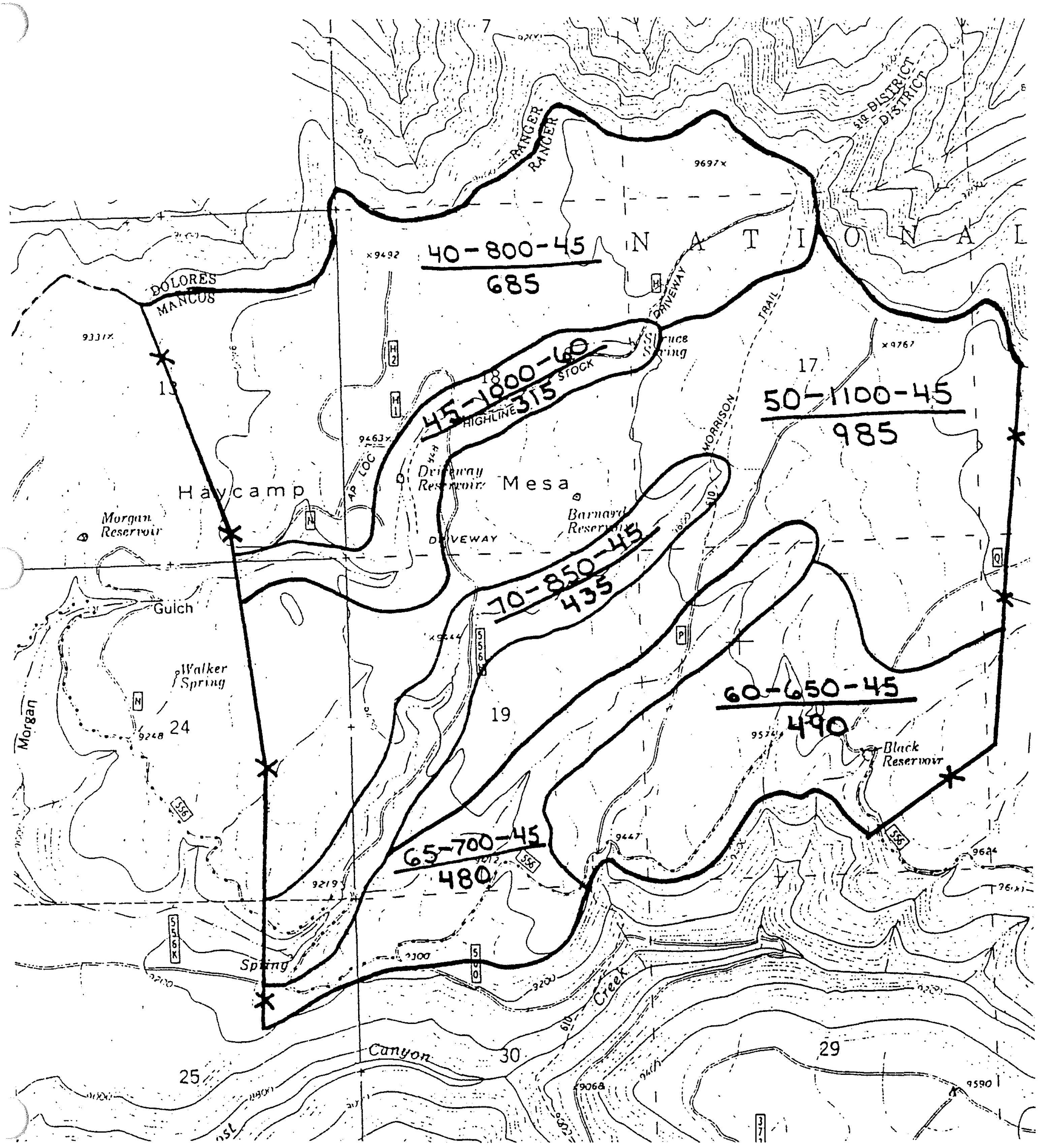
An estimate of grazing capacity should also be made using the following formula:

$$\frac{\text{Annual Area Use Factor}}{\text{AMs Actual Use}} = \frac{\text{Allowable Area Use Factor}}{x}$$

5. A narrative should be prepared for each year of the study and at the conclusion of the study. These narratives should include: actual use data, a description of the study process, methods used to collect data, weather information, general observations, conclusions/recommendations, and the forms and maps. Permittees should be included in the study and updated on each year's results. The narrative is vital in helping the permittee and decision maker understand how the data can be used in estimating grazing capacity and altering management strategies.

A study of this type could easily be adjusted to incorporate the use of Residue Methods in lieu of Utilization Methods.

Figure 4-7. USE ZONE MAP



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PRODUCTION UTILIZATION SUMMARY (R2-2200-PUSum)

Forest	District	Plot ID
BIGHORN NF	**BUFFALO RD**	

Allotment Name and Number	Pasture
TABLE MOUNTAIN	**PAT PARK**

Kind/Class & Number of Animals	Period of Use	Actual Use
825 C/C	**6/1 - 7/15**	**1238** Animal Months

Date	Examiner(s)
07/21/94	**J. DAWKINS**

$$\frac{\text{Annual Area Use Factor}}{\text{AMs Actual Use}} = \frac{\text{Allowable Area Use Factor}}{x}$$

Acres	Actual % Use	Annual Area Use Factor	Allowable % Use	Allowable Area Use Factor	Remarks
685	**40**	**27,400**	**45**	**30,825**	
315	**45**	**14,175**	**60**	**18,900**	
985	**50**	**49,250**	**45**	**44,325**	
435	**70**	**30,450**	**45**	**19,575**	
480	**65**	**31,200**	**45**	**21,600**	
490	**60**	**29,400**	**45**	**22,050**	
3,390		**181,875**		**157,275**	Totals (or Subtotals)

For example:

$$\frac{181875}{1238} = \frac{157275}{x}$$

$$181875x = 157275 \times 1238$$

$$x = 1071 \text{ AMs Desired}$$

1238 AMs Used
<u>- 1071 AMs Desired</u>
167 AMs Over - obligated

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RIPARIAN ECOSYSTEMS

INTRODUCTION

Riparian areas are usually associated with intermittent or perennial streams, lakes, reservoirs, wet meadows, and springs. Though riparian areas constitute a small fraction of most rangeland areas, they are more productive in terms of biomass per unit area and species diversity than the remaining land base. Hydrologic function, including water quantity, quality, and timing of flow, is a major concern in managing riparian ecosystems.

Characteristics of riparian areas are largely dependent upon overall landscape and watershed characteristics and functions. For this reason, riparian inventory and evaluation procedures must be conducted in conjunction with the overall rangeland analysis process. Use Integrated Resource Inventory (IRI) mapping standards and guidelines to delineate map units. The methods and procedures found in this Guide supplement IRI direction.

A variety of resource attributes must be examined to adequately describe riparian areas. This Guide identifies the necessary standards and guidelines for rangeland managers to adequately inventory and evaluate the vegetation component and selected stream morphology characteristics of riparian ecosystems.

Much of this Chapter is extracted from the "Integrated Riparian Evaluation Guide", developed by the Intermountain Region (1992). That Guide is an excellent reference and further explains procedures outlined in this Chapter.

COMPLEX CHARACTERIZATION

Riparian areas are typically composed of a mixture of different communities. For example, one or more willow, cinquefoil, Kentucky bluegrass, sedge, and sandbar communities may occur in repeating patterns within a specific riparian area. There are often four to as many as ten different community types within a riparian complex. Their distribution is dependent on the inherent dynamic nature of riparian ecosystems. Variation in community types is also dependent on various disturbance types such as grazing use, recreational activities, or road construction.

It is normally valuable to describe a riparian area in terms of the relative distribution of the various plant communities present. Trend can then be determined by observing distribution changes in the composition of plant communities on a site.

EXISTING VEGETATION

The three standard inventory methods (ocular plant composition, cover-frequency transect, and line intercept) described in the Inventory Chapter (Chapter 3) are used to inventory riparian vegetation. Follow instructions in the Inventory Data Application Section (page 3-13) to determine either vegetation management status or ecological status depending on whether an ecological type classification is available.

Since the Rocky Mountain Region does not presently have ecological type classifications, use the community type classification publications developed by the Intermountain Region as references for seral and potential natural communities (listed below). Riparian communities in the Intermountain and Rocky Mountain Regions appear to be very similar, perhaps as much as an 80 percent overlap (Al Winward, personal communication). The overlap is obviously more significant in the western portion of the Rocky Mountain Region.

> Padgett, Wayne G.; Youngblood, Andrew P.; Winward, Alma H. 1989. Riparian community type classification of Utah and southeastern Idaho. Ogden, UT: USDA Forest Service, Intermountain Region, R4-Ecol-89-01. 191 pp.
>
> Youngblood, Andrew P.; Padgett, Wayne G.; Winward, Alma H. 1985. Riparian community type classification of eastern Idaho - western Wyoming. Ogden, UT: USDA Forest Service, Intermountain Region, R4-Ecol-85-01. 78 pp.

Appendix G lists late and early seral designations for the community types described in Intermountain Region publications. Use "Plant Associations of Region 2" (Johnston, 1987) either as a cross-reference with the Intermountain Region publications or as a supplemental source for identification of riparian communities that perhaps do not occur in the Intermountain Region or have not yet been described within this Region.

PRIORITIES AND INTENSITY

Use judgment to determine the intensity levels of inventory and monitoring needed for each riparian area. Factors to be considered in determining inventory intensity are: complexity or sensitivity of known or anticipated resource use conflicts or controversy, diversity of vegetation types, present ecological status, trend, and the desired level of precision. Refer to the analysis priority and intensity discussions in the Inventory Chapter (page 3-3). Table 3-1 (page 3-4) provides a useful reference for determining the magnitude of the project and the appropriate level of inventory intensity.

METHODS

The level of inventory is based on circumstances surrounding the need for inventory. The Inventory Chapter (page 3-33) addresses how to evaluate which level of inventory to use. In general, the more complex the management situation, the greater the need for increased levels of inventory.

BASE LEVEL INVENTORY

For most routine situations where the examiner has determined that natural resource conflicts and the potential for controversy are minimal, consider the following as base level requirements for riparian inventory.

1. Map riparian polygons following Integrated Resource Inventory procedures (IRI Training Guide).

2. Inventory vegetation using the three standard methods described in the Inventory Chapter (page 3-33).

3. Identify the stream channel type using Rosgen's stream channel classification (Figure 5-1). There are additional diagrams and illustrations in Appendix H which define stream channel types and will assist in determining the stream channel classification.

4. Rate the stream channel characteristics using the Riparian Characteristic Evaluation Form (R2-2200-RCS).

5. In cases where there are several community types making up a riparian complex, visually estimate the relative occurrence of the various communities. Record this information on the Riparian Characteristic Evaluation Form (R2-2200-RCS).

HIGHER LEVEL INTENSITY INVENTORY

In those situations where natural resource conflicts or a high level of controversy exists, or potentially may develop, more intense inventory and monitoring techniques will be required. The interdisciplinary approach to inventory and allotment management planning is essential to successful management of riparian ecosystems. ***Note that at this level of intensity and controversy, it is strongly recommended that fisheries biologists and hydrologists be included as part of the inventory team, if they are not already.*** The following methods will supplement base level inventory procedures.

Cross-Section Composition

This method quantifies the distribution of riparian communities from the upland communities on one side of the stream, through the stream, to the upland communities on the other side (page 5-13). This is important because not all riparian communities occur at the water's edge.

Green Line Vegetation

This method quantifies the distribution of riparian ecosystems along the green line, that is the nearest occurrence of perennial vegetation to the water's edge (page 5-17). This is important because riparian communities along the green line are the most critical in maintaining healthy hydrologic function within the riparian area.

Woody Species regeneration

Specifically quantifying woody species regeneration assists in monitoring the trend of the riparian area (page 5-23).

Figure 5-1. STREAM REACH CHANNEL TYPE KEY (ROSGEN)

1a Single Channels.. *Go to 2*

2a Entrenchment = Well Entrenched (< 1.4) .... *Go to 3*

3a Shape = Low W/D (< 12)........................ *Go to 4*

4a Sinuosity = Straight (< 1.2) .... **A**

4b Sinuosity = Sinuous (1.2-1.4) .... **G**

3b Shape = Moderate to High W/D (> 12);
Sinuosity = Meandering (> 1.4) .... **F**

2b Entrenchment = Moderately to Not Entrenched (> 1.4)
.... *Go to 5*

5a Entrenchment = Moderately Entrenched (1.4-2.2);
Shape = Moderate W/D (14-26);
Sinuosity = Sinuous (1.2-1.4) .... **B**

5b Entrenchment = Not Entrenched (> 2.2) .. *Go to 6*

6a Shape = Very Low W/D (< 10);
Sinuosity = Meandering (> 1.4) .... **E**

6b Shape = Moderate to High W/D (> 12);
Sinuosity = Meandering (> 1.4) .... **C**

1b Multiple Channels (Entrenchment Not Applicable);

7a Shape = Very High W/D (> 40);
Sinuosity = Tortuous (> 2/0)...................................... **D**

7b Shape = Moderate to High W/D (< 40)................... **DA**

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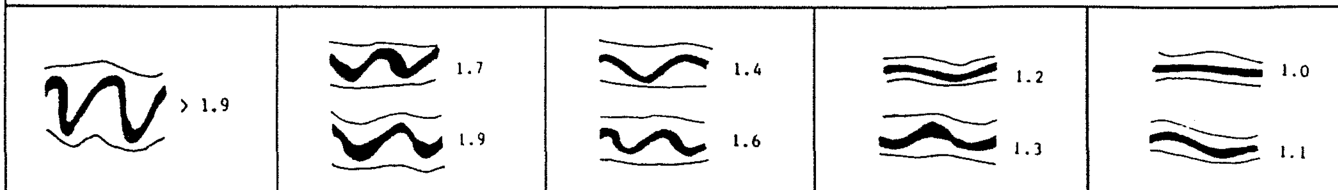
RIPARIAN CHARACTERISTICS EVALUATION SHEET

Streams **(Circle descriptions that fit best)** **(R2-2200-RCS)**

Stream Bank Stability

Stream bank damage <5%; no mass wasting; plants of high vigor and deep, binding root systems holding banks intact; no overflows beyond channel confines.	Stream bank damage 5-15% mainly at curves and constrictions; infrequent mass wasting; vigor moderately high; normally healthy root systems effectively hold bank in place; overflows beyond channel confines are rare.	Stream bank damage 16-30%; bank mass wasting occurring at critical locations, moderate plant vigor with root systems barely able to stabilize banks; channel at times inadequate for peak flows.	Stream bank damage 31-45%; discontinuous mass wasting, with little healing; low plant vigor and weak root systems allowing frequent bank breakdown; channel inadequate to hold peak flows.	Stream bank damage >45%; bank overhang failures frequent and year-long vegetation cover sparse with weak, shallow root systems, often exposed; channel inadequate for frequently occurring floods.

Meander



Tree Overstory

Stands mostly discontinuous; >40% canopy cover; 4+ size classes; deciduous trees dominant, occasional conifers, single species may dominate; light use; regeneration linear and vigorous.	Stands discontinuous; 25-40% canopy cover; 3-4 size classes; deciduous trees dominant, conifers infrequent; light to moderate use on regeneration.	Stand canopy 11-25%; interspaces partially filled with shrubs and grasses; 2-3 tree size classes present; exotics minor component; moderate use or damage; regeneration adequate to replenish stand.	Tree canopy 5-10%; 1-2 size classes, with only decadent stand common; heavy use; seedlings and sprouts sparse and heavily damaged; new stands not establishing; exotics invading.	Canopy <5%; trees very scattered or entirely lacking; very heavy use and damage; no regeneration of native trees; exotics often dominate

Shrub Midstory

Shrub canopy >50%; 2+ palatable species present, but single genus, such as *Salix* may dominate; growth form linear; light browsing on most palatable species.	35-50% shrub canopy; variety of species, single palatable species dominance more common; growth form linear, with lateral branching from light browsing.	Canopy cover 21-35%; some weakened desirable species; intermediate species can dominate; lateral branching common from moderate use; regeneration limited.	Canopy cover 10-20%; single age classes and single species dominate; heavy browsing causing clubbed appearance; little to no reproduction of desirable species.	Canopy cover <10%; only unpalatable shrubs present in sizable numbers, or shrubs lacking; remnant desirable shrubs severely clubbed; no regeneration.

Understory

Desirable grasses and sedges dominate; forbs limited to those which are highly palatable; >90% ground cover; plants vigorous with large seed heads; desirable seedlings or litter fill bare spaces; light use >5%.	Some intermediate plants, up to 25% in composition but dominated by desirables; perennial forbs a component of the understory; ground cover 80-89%; seed heads common; trampling minimal; light to moderate use.	Intermediate grasses and perennial forbs common; few least desirables; 65-79% ground cover; vigor down; some seed heads on less palatable grasses; soil trampling evident; use moderate to heavy.	Intermediate plants dominate with a few remnant weakened relic desirable plants, invader plants common; 50-64% ground cover; vigor down due to heavy current use; soil movement evident.	Intermediate and least desirable plants dominate; <50% ground cover; bare spaces increasing; very heavy current use; overland erosion and soil compaction rampant.

If damage is occurring what are the probable damaging agents:

____ None	____ Livestock grazing	____ Road building
____ Natural	____ Tree or shrub removal	____ People concentration and trampling
____ Upstream building	____ Beaver activities or dam failure	____ Dam breaching or failure
____ Upstream or adjacent cultivation	____ Channelization	____ Excessive dewatering
____ Burning	____ Dredging	____ Other
____ Big game browsing and concentration	____ Mine tailings	

Relative community distribution, remarks, and recommendations: ____________________

____

____

____

RIPARIAN CHARACTERISTICS EVALUATION SHEET (R2-2200-RCL)

Lakes and Reservoirs (Circle descriptions that fit best)

Tree Overstory				
4-5 size classes present with willow or cottonwood dominant; discontinuous stands or clumps with >35% canopy coverage; sprouts and seedlings vigorous.	2-3 size classes present; frequently single species; trees in clusters with canopy cover 20-35%; at least half of regeneration surviving.	Commonly 1-2 size classes, mature and overmature; canopy cover 5-19%; browsing moderate resulting in suppressed regeneration; exotics may occur, but rare.	Native trees usually decadent; total tree canopy cover <5%; heavily browsed and inadequate sprouts or seedlings for regeneration; exotics common.	No native trees present, or if present very suppressed and severely browsed and damaged; exotics commonly dominant if trees exist.
Shrub Midstory				
Variety of age/size classes; however only a single willow species may occur; canopy cover >30%; little to no use, rubbing, or trampling.	Several age classes represented; willow monocultures common; canopy 15-30%; light use, rubbing, or trampling; mostly linear growth.	2-3 age/size classes; shrub canopy 5-14%; some dead wood in older plants from moderate browsing, rubbing, or trampling; exotics may occur.	Very few native shrubs which are severely clubbed; <5% canopy cover; exotics commonly dominate with heavy animal damage; few sprouts or seedlings; much dead wood in older shrubs.	No native shrubs present; the stand composed of heavily damaged exotics, or shrubs lacking; at least 5 years since impoundment built.
Understory				
A variety of plants present, mainly dominated by desirable grasses and sedges; a few forbs will occur; ground cover 95-100%; plants vigorous with many large seed heads; little to no use.	Desirable grasses and sedges dominant; intermediates and least desirables not over 1/3 the stand; ground cover 85-94%; vigor good and seed heads common; light use < 15%.	Intermediate plants common; annual forbs evident; some desirables remaining, but not over 30% of composition; ground cover 70-84%; few seed heads on more palatable plants; vigor fair; use 16-35%.	Intermediate plants dominant with least desirable forbs a conspicuous component; desirables stunted relics; ground cover 50-69%; seed heads on increasers; use 36-60%.	Annual least desirables dominant; intermediates of low vigor; no desirables; ground cover <50%; bare spots not filling as fast as occurring; heavy use >60%.
Shoreline				
<5% of shoreline and riparian zone trampled or otherwise disturbed; no evidence of silt or sand deposition at inlets; water can clear between storms.	5-15% annual disturbance; slight evidence of siltation and deposition; water a little cloudy after intense storms.	16-40% of shoreline and riparian annually trampled or disturbed; silt depositions and cloudy water common after storms.	41-60% annual disturbance; silt deposits and new bar buildup after most storms; water remaining cloudy for long periods after storms.	>60% annual disturbance; new silt deposits in all inlets after storms; water continually cloudy with suspended sediments.

If damage is occurring what are the probable damaging agents:

____ None	____ Livestock grazing	____ Road building
____ Natural	____ Tree or shrub removal	____ People concentration and trampling
____ Upstream building	____ Beaver activities or dam failure	____ Dam breaching or failure
____ Upstream or adjacent cultivation	____ Channelization	____ Excessive dewatering
____ Burning	____ Dredging	____ Other
____ Big game browsing and concentration	____ Mine tailings	____________

Relative community distribution, remarks, and recommendations: ____________________

____

____

____

____

RIPARIAN CHARACTERISTICS EVALUATION SHEET
(R2-2200-RCW)

Woody Draws (Circle descriptions that fit best)

Trees				
Canopy cover >10%; several native species; 3-5 size classes; light to no browsing or rubbing damage; regeneration common.	Canopy cover 5-10%; 2-3 size classes of indigenous trees; light to moderate damage from rubbing and browsing; adequate regeneration.	Canopy cover <5%; 1-2 size classes of native and exotic trees; heavy browsing and rubbing damage; sparse and barely adequate regeneration.	Trees rare, mainly decadent; very heavy damage; exotics may dominate; no regeneration.	No trees present.
Shrubs				
Variety of palatable shrubs; canopy cover > 50%; all size classes; linear growth; use and damage barely noticeable.	Desirable shrubs dominate with up to 25% of stand intermediates and least desirables; canopy cover 30-50%; linear growth common with light browsing and rubbing.	Desirable shrubs <15% of stand; intermediates dominant with up to 20% least desirables; canopy cover 10-29%; palatable shrubs heavily damaged from browsing and rubbing; few young plants.	Intermediate-least desirable shrubs over 75% of stand; desirables rare; canopy cover <10%; heavy damage on intermediates and desirables; no regeneration of palatable species.	Few to no intermediates or least desirables dominant, or shrubs lacking.
Understory				
Vigorous grass stand with a few desirable forbs; desirables over 75% of composition; ground cover >85%; mulch and duff layer under dense tree-shrub canopy.	Desirable-intermediate grass stand with occasional forbs; smaller and fewer seed heads; ground cover 75-85%; moderately vigorous; light duff cover under trees and shrubs.	Intermediates over 50%; desirables infrequent and weak; least desirables 10-20%; ground cover 60-74%; mulch and duff absent or trampled into soil; desirables not reproducing.	Intermediate-least desirable stand with desirables rare; forbs common; ground cover 40-59%; heavy annual use>60%; seedlings mainly least desirables.	Mostly forb least desirables over 50% of stand; intermediates weak and scattered; ground cover <40%; little or no seed production.
Soil and Water				
Little or no trampling or compaction; ground cover effective in preventing erosion; flooding infrequent and not detrimental; strong root systems holding soil in place.	Trampling resulting in compaction on 10-25% of area; plants and litter generally effective in preventing erosion, except in high intensity storms; root systems adequate.	Trampling and compaction on 26-50% of area; some soil movement from limited litter and plant cover; plant roots barely effective in halting erosion in downpour rains.	Trampling and compaction on 51-75% of area; overland water movement and erosion common even with moderate rains; debris lodging in shrubs; roots weak and ineffective in halting erosion.	Trampling and compaction on >75% of area; new silt and sand deposits common with each rain; root systems often exposed and ineffective in holding soil in place.

If damage is occurring what are the probable damaging agents:

____ None
____ Natural
____ Upstream building
____ Upstream or adjacent cultivation
____ Burning
____ Big game browsing and concentration
____ Livestock grazing
____ Tree or shrub removal
____ Beaver activities or dam failure
____ Channelization
____ Dredging
____ Mine tailings
____ Road building
____ People concentration and trampling
____ Dam breaching or failure
____ Excessive dewatering
____ Other
____

Relative community distribution, remarks, and recommendations: ____________________

____

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MONITORING RIPARIAN AREAS

Monitoring riparian areas is similar to monitoring uplands. It can be categorized into short- and long-term methods. Keep in mind the following key items for both situations:

1. establishment and survival of deep-rooted shrubs and herbaceous species,

2. stream bank stability,

3. soil compaction and erosion,

4. browsing levels on brush species,

5. utilization of herbaceous species, and

6. level of controversy and resource use conflicts.

SHORT-TERM MONITORING

Monitoring intensity should be commensurate with the degree of resource conflicts and/or controversy associated with the area. The amount of time and effort devoted to monitoring riparian areas should be at the discretion of the rangeland manager.

It is recommended that for normal grazing administration in riparian areas, the following be used as general guidelines for short-term monitoring.

1. Assess stream bank stability and move livestock before unacceptable levels of stream bank trampling occur. Recent experience in southwestern Montana suggests that damage to stream banks begins to reach problem levels as forage becomes short (Beaverhead National Forest, 1993). The upper limit to ***tolerable*** stream bank impacts is approximately 30 percent. Therefore it is imperative that stubble height standards be closely followed. The amount of trampling allowed must be adjusted by stream type and the desired condition. Refer to standards and guidelines from the Forest Plan for more information.

2. Use stubble height and regrowth standards from the Intermountain Region (Clary and Webster[1]). Once livestock exceed allowable use levels on herbaceous plants, they begin to browse shrubs and walk up and down the riparian corridor.

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[1]Clary, Warren P. and Webster, Bert F. 1989. Managing Grazing of Riparian Areas in the Intermountain Region. USDA Forest Service, Intermountain Research Station, Gen. Tech. Rep. INT-263.

This is when soil compaction, stream bank trampling, and shrub hedging begins to exceed acceptable levels.

3. Observe hedging on shrubs and use the general browse utilization guide from the Monitoring Chapter (page 4-51). Light to moderate use during dormancy usually does not adversely affect shrubs. Be aware of the correlation between forage use levels, time of use, and the resultant use on shrubs if livestock are left in a riparian area too long.

LONG-TERM MONITORING

Start with cover-frequency and/or line intercept inventory methods. Use the cross-section composition, green line transect, and woody species regeneration sampling methods as needed, particularly to detect changes in relative plant composition distribution. Repeated application of these techniques to determine vegetation characteristics for a complex provides the basis for assessing trends in riparian area vegetation condition through time.

CROSS-SECTION COMPOSITION
R2-2200-CS

GENERAL DISCUSSION

The Cross-Section Composition Method is used to describe and quantify the distribution of riparian communities within the riparian area. This information is important because:

- the distribution of individual plant communities within a riparian ecosystem is often very dynamic, and

- not all riparian communities occur at the water's edge.

This method is used for both inventory and monitoring purposes.

TRAINING

The Cross-Section Composition Method does not require intensive training for field application. Both small and large riparian areas can be sampled quickly. Examiners must be able to recognize different communities and identify where the change between communities occurs. The most complicated aspect of this method is to record the number of feet per community for all communities on each cross-section.

PERSONNEL AND EQUIPMENT

One person can complete and record cross-section composition transects, however it is easier and more efficient for a second person to function as a recorder. The equipment required to complete this method are stakes to mark the transect ends, a hand-held counter, and a camera.

SAMPLING PROCEDURE

At least five paced transects are established perpendicular to the riparian complex in such a way as to cross the entire riparian area (Figure 5-2). More transects should be established if the riparian area is too large for five transects to describe, or if variability warrants. Start at the lower end of the riparian area with the first cross-section composition transect and work your way up stream.

Beginning and ending points for each transect are permanently marked with stakes. The permanent stakes should be placed far

enough back into the non-riparian area to allow subsequent measurements in case the riparian area expands. ***Note that in this method the examiner is measuring the intercept of plant communities, not individual plant species.***

Community type composition is obtained by tallying the number of feet encountered for each type in relation to the number of total number of feet used in all transects. A hand held counter will aid in this sampling process. Note, since different individuals have distinct step lengths each person should test themselves with a measured transect so that steps can be converted to feet. Use the Cross-Section Composition Form (R2-2200-CS) to record the number of steps for each transect and the Cross-Section Composition Summary Form (R2-2200-CSSum) to summarize the community distribution for the entire riparian area.

More precise quantification of ground cover may be preferred by hydrologists. Implement and use those measurements as available and necessary.

PHOTOGRAPHS

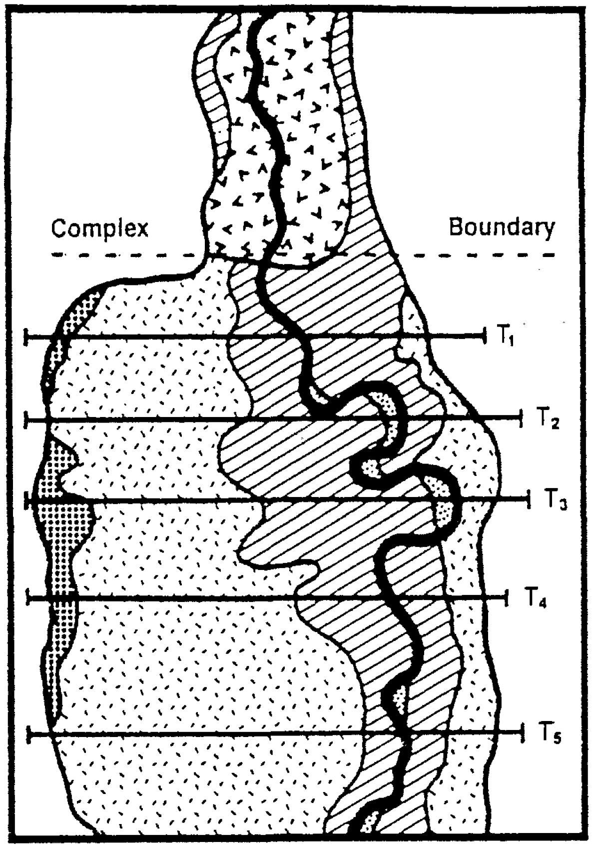
Photographs will be taken at each of the starting points. The objective of the photographs is to depict the setting of the cross-section. Photographs are also taken at the location(s) where the cross-section crosses the stream channel. Additional photos may be taken from the ending point as well. Be sure to include permanent landscape features wherever possible to assist in geo-referencing the transects.

EXAMPLE

Percent composition for each community type is calculated on the Cross Section Summary Form (R2-2200-CSSum) and is illustrated on the sample form. Composition of the Kentucky bluegrass (POPR) community type is 56 percent (280 feet/500 feet). Similarly the composition of the redtop (AGST2) community type is 6 percent. Composition for all community types encountered in the complex should total 100 percent.

Figure 5-2. VEGETATION COMPOSITION WITHIN A COMPLEX

Use the cross-section composition method to measure community type composition. Subsequent measurements measure and document amount of change in relative abundance of each community type.



	T_1	T_2	T_3	T_4	T_5	% Comp.
Alder/ Dogwood						
Willow/ Beaked Sedge	40	45	35	25	20	(33)
Kentucky Bluegrass	50	45	45	60	80	(56)
Redtop		10	5	15		(6)
Catgrass	10	T	15			(5)

Percent Disturbed = 62

CROSS-SECTION SUMMARY
(R2-2200-CSSum)

Forest WHITE RIVER NF	District HOLY CROSS RD	Date Compiled 94/08/12
Drainage ELK CREEK		
Examiner(s) B. SAGE		Photo Number(s) 4-9
Complex		
Transect No.		

Community Type	T_1 (feet)	T_2 (feet)	T_3 (feet)	T_4 (feet)	T_5 (feet)	TOTAL (feet)	Percent Composition Total Riparian
Transect Length	100	100	100	100	100	500	
POPR	50	45	45	60	80	280	56
SALIX/CAUT	40	45	35	25	20	165	33
DAIN	10	T	15			25	5
AGST2		10	5	15		30	6
					GRAND TOTAL	500	100%

GREEN LINE VEGETATION COMPOSITION
R2-2200-GL

GENERAL DISCUSSION

Sampling community type composition along edges of live water can provide additional information over that collected by the cross-section process. Presence of permanent water in the plant rooting zone allows more rapid recovery of vegetation after disturbances. This permits a rangeland manager to make an earlier evaluation of management intended to improve riparian condition. Also, measurement of this portion of the riparian area provides an indication of short-term trend for the riparian area. This is where the forces of water, as influenced by total watershed condition, play their most prominent role.

Additionally, there is a strong relationship between amount and kind of vegetation along the water's edge and bank stability. Natural plant species in this permanently watered area have developed rooting systems which enhance bank stability. An evaluation of the vegetation in this area can thus provide a good indication of the general health of the watershed, as well as the stream..

The green line is defined as that specific area where a more or less continuous cover of perennial, hydric vegetation is encountered when moving away from the perennial water source (Figure 5-3).

At times, the green line may be at the water's edge. Or, it may be part way back on a gravel or sandbar. The green line may be only a foot or two wide, or may be many feet wide, depending on soil and water features. Native plant species forming the green line, such as beaked sedge or water sedge are generally good buffers of water forces. Disturbance activities, such as overgrazing or trampling by animals or people, result in changes to species such as Kentucky bluegrass or redtop, both of which have a reduced ability to buffer water forces.

In most riparian settings, there is a continual effort by nature to form this green line of vegetation, even where the adjacent community types are composed of the more shallow-rooted species. Well developed green line vegetation stabilizes channel banks and buffers water forces. This enhances channel stability, even for inherently unstable stream types. Therefore, an evaluation of the

community type composition of the green line can provide a good indication of the general health of the riparian area.

TRAINING

The Green Line Vegetation Composition Method does not require intensive training for field application. Examiners must be able to recognize different communities and identify where the change between communities occurs. The most complicated aspect of this method is to record the number of feet per community for all communities on each cross-section.

Examiners should work closely with District or Forest hydrologists or fisheries biologists to learn to estimate percent composition of different stream substrates. In addition, examiners must be able to recognize characteristics of stable and unstable stream banks.

PERSONNEL AND EQUIPMENT

One person can complete and record green line vegetation composition transects, however it is easier and more efficient for a second person to function as a recorder. The equipment required to complete this method are stakes to mark transect ends, a hand-held counter, and a camera.

SAMPLING PROCEDURE

The green line transect begins on the right-hand side of the stream (looking upstream) at the point where the first cross-section composition transect intercepts the green line (Figure 5-3). In settings where the stream has multiple channels, use the current, most dominant channel. Sampling proceeds up the green line using a paced transect, as described in the cross-section composition measurement, instead of a stretched tape.

Enough steps should be taken to total 363 feet linear distance; the number of steps will vary from examiner to examiner. A temporary marker is placed at the end of the transect for location of subsequent shrub measurements. The examiner then crosses the stream and repeats the sampling process for 363 feet downstream. Use the Riparian Green Line Transect Data Form (R2-2200-GL) to record the number of steps for each transect and the Green Line Summary (R2-2200-GLSum) to summarize the community distribution for the entire riparian area.

Start and stop counts are recorded for every community type change. Subsequent measurements of the same area provide a measurement of trend for that complex. Indicating start and stop counts on the form will assist in evaluating trend later. In addition, they are important cross references with aquatic surveys.

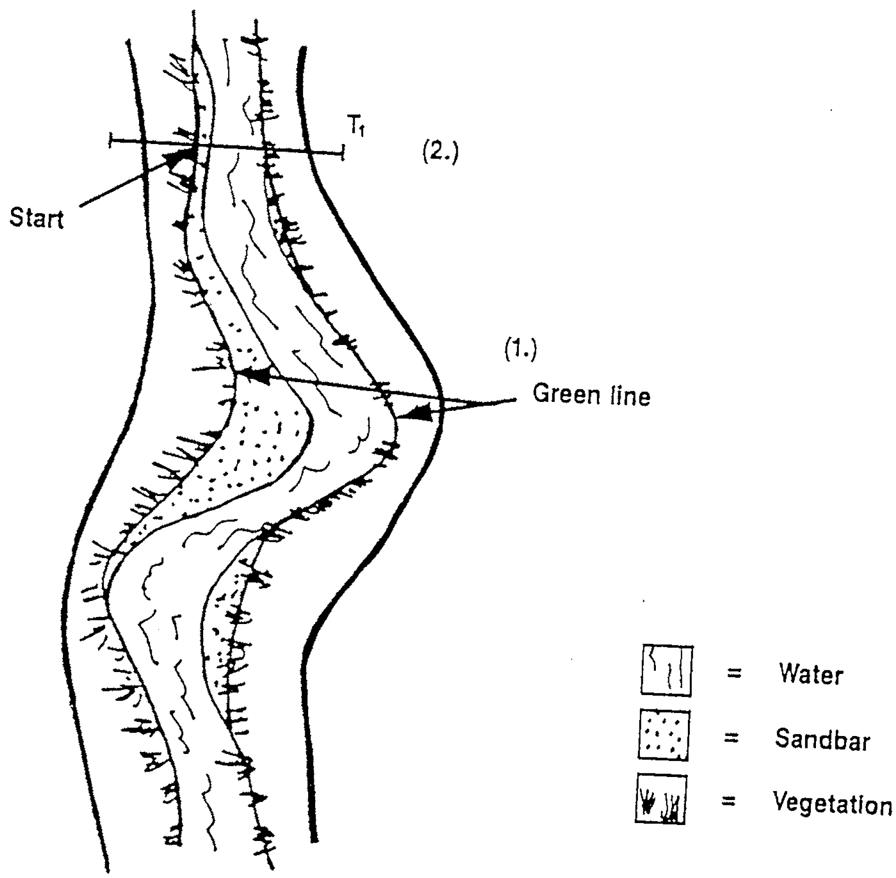
NOTE: The stopping point may not coincide with the initial starting point on the other side of the stream due to difference in lengths of meanders on each side of the stream. It is important to sample both sides of the stream since activities (grazing pressures or water forces) may be different on each side.

On certain streams, especially those with steep gradients, the number of feet of large anchored rocks or large logs should be tallied in addition to the vegetation. Rocks and logs must be large enough to withstand the forces of water and must appear stable in the setting being measured. The number of feet of rocks and logs would be counted as a natural stable percentage of the green line. Also tally the number of feet of disturbed or damaged stream bank. This gives an accurate measure of the amount of disturbance.

Experience in all Regions has shown that stream bank stability is a critical characteristic for initial inventory and monitoring of grazing programs. Stream substrates are also important from fisheries and stream health perspectives. Fill out estimates of stream bank stability and stream substrates when doing the green line transect.

Figure 5-3. GREEN LINE VEGETATION COMPOSITION MEASUREMENT

Location of (1) the green line in relation to the water's edge and to sandbars and (2) location of the green line transect in relation to the cross-section composition transect.



NUMBER OF TRANSECTS

The number of green line transects measured is dependent on the inventory intensity, and the complexity and size of the riparian ecosystem. As many as one green line transect may be established for each cross-section composition transect. At least one green line transect should be established for every grouping of cross-section composition transects.

COMPUTATIONS

The total number of feet of each community type encountered along the green line is tallied and composition for each type computed as described in the cross-section composition measurement. For example:

$$\frac{\text{Total Feet of Each Type (Left + Right Side)}}{\text{726 Ft (363 Ft Minimum Each Side)}} = \text{CT Composition}$$

PHOTOGRAPHS

A photograph can be taken at the starting point of the green line transect, looking upstream. Additional photos may be taken along the transect if desired. These photographs should include permanent landscape features wherever possible to assist in geo-referencing the transects so they can be re-established in the future.

Conduct a woody species regeneration survey on the same transect location using Form R2-2200-WS (page 5-23).

GREEN LINE SUMMARY (R2-2200-GLSum)

Forest **WHITE RIVER NF**	District **HOLY CROSS RD**	Date Compiled **94/08/12**
Drainage **ELK CREEK**		
Examiner(s) **B. SAGE**		Photo Number(s) **4-9**
Complex		
Transect No.		

Community Type	T_1 (feet)	T_2 (feet)	T_3 (feet)	T_4 (feet)	T_5 (feet)	COMPOSITION Total Feet	Percent
SALIX/CAUT	**327**	**301**	**319**	**298**	**284**	**1529**	**84%**
AGST2	**36**	**44**	**29**	**65**	**54**	**228**	**13%**
POPR		**18**	**15**		**25**	**58**	**3%**

STREAM SUBSTRATE	PERCENT
Sand/Silt/Clay (<2 mm)	**45%**
Gravel (2-63 mm)	**35%**
Cobble-Boulder (>63 mm)	**15%**
Bedrock	**5%**

BANK STABILITY (estimate to nearest 10 percent)	PERCENT
Vegetated-Stable: bank is vegetated with no evidence of active erosion or sloughing and no tension fractures.	**60%**
Vegetated-Unstable: bank is vegetated, but tension fractures exist at the top of the bank.	**20%**
Unvegetated-Stable: Bank is not vegetated, but is composed of bedrock or stable boulders or cobbles.	**15%**
Unvegetated-Unstable: Bank is not vegetated and is composed of bare gravel, sand, silt, or clay, or a matrix of cobbles and these finer particles.	**5%**

WOODY SPECIES REGENERATION
R2-2200-WS

GENERAL DISCUSSION

Not all riparian areas are well suited for growing woody species. This appears to be especially true where the complex has a low gradient and a limited amount of natural stream channel movement. In these settings, understory sedges and rushes are able to buffer the forces of water without the addition of woody species. Most of the woody riparian species in the Intermountain Region regenerate best in settings where there is minimal competition from herbaceous species.

TRAINING

The Woody Species Regeneration Method does not require intensive training for field application. Examiners must be able to recognize woody plants by species in varying forms of maturity and hedging. The most complicated aspect of this method is to record the number of feet per species for all woody species along the green line.

PERSONNEL AND EQUIPMENT

One person can complete and record woody species regeneration transects, however it is easier and more efficient for a second person to function as a recorder. The equipment required to complete this method are a 6-foot pole with the center marked, a hand-held counter, and a camera.

SAMPLING PROCEDURE

A measurement of woody species regeneration is made along the same paced line as is the green line transect (Figure 5-4). The examiner uses a 6-foot pole which has the center marked. Measurements are made by walking 363 feet on each side of the stream with the center of the pole held directly over the edge of the green line adjacent to the water body. Using the green line edge as the center of the measurement helps to assure that the sampling is done in a setting where regeneration is most likely to occur.

Modification of the above procedure may be necessary for narrow water bodies. In these settings do not allow the left tip of the pole to extend beyond the center of the water body. When that occurs,

align the left tip of the pole on the center of the water body (the pole is no longer centered on the green line edge). This modification eliminates double sampling when measuring from both sides, yet insures that a full one-tenth acre area is sampled.

All woody species rooted within the ends of the pole (3 feet either side of the green line) are tallied based on the following age class categories.

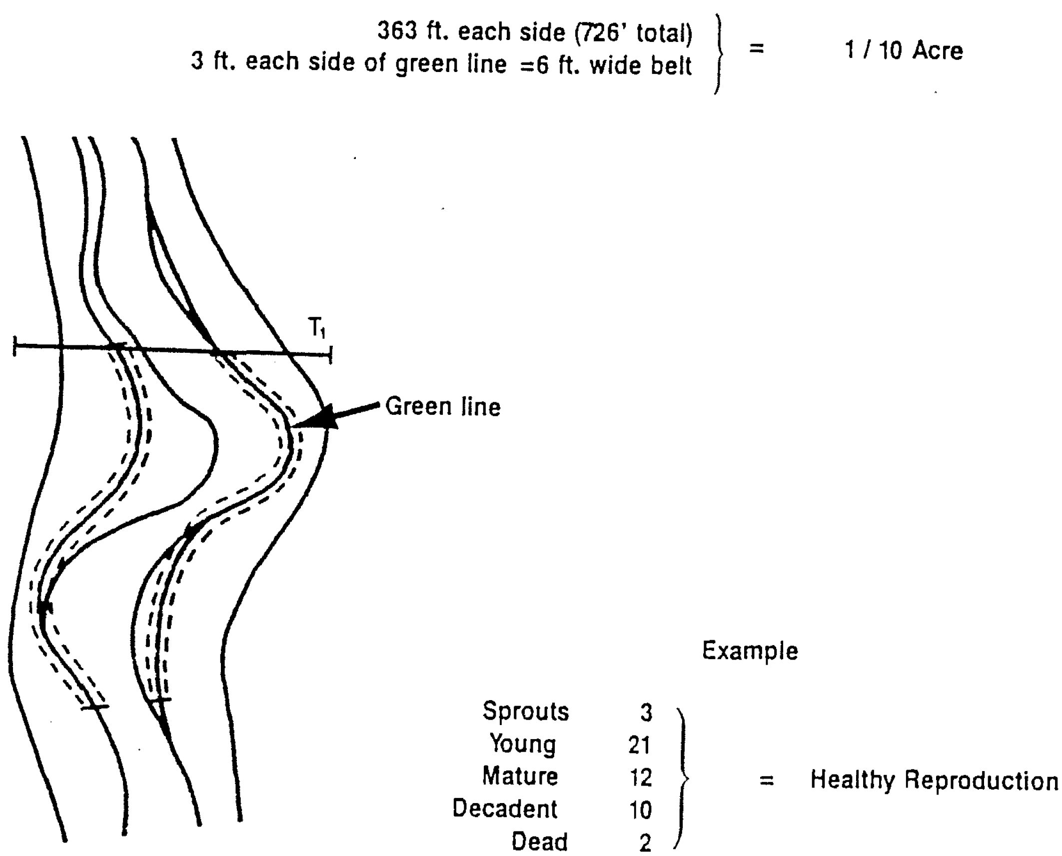
	Number of Stems	Age Class
1	Number stems = 1	sprout
2	Number stems = 2 to 10	young
3	Number stems = >10, >1/2 alive	early mature
4	Number stems = >10, <1/2 alive	late mature
5	Number stems = 0 stems alive	dead or decadent

A tally of shrubs by age class provides a preliminary indication of regeneration of shrubs in that complex. A high proportion of plants recorded in the sprout, young, and early mature categories would indicate the shrub component in this complex is in an upward trend. Conversely, low numbers of plants in the sprout and young categories would indicate current management may be suppressing woody species. A comparison of settings where the complex is in as close to PNC as possible may be used as a standard to evaluate overall shrub status. Subsequent measurements on the same area will provide a measurement of woody species regeneration trend. Use the Woody Species Regeneration Form (R2-2200-WS) to record the number of steps for each transect and the Woody Species Regeneration Summary Form (R2-2200-WSSum) to summarize the species distribution for the entire riparian area.

For smaller statured species such as *Salix wolfii*, change the number of stems upper limit from ten to five for the young, early mature, and late mature age classes. For single-stemmed species such as *Salix exigua*, *Betula* spp., and *Alnus* spp., count each stem that occurs 12 or more inches from another as a separate plant. Place these into age classes based on overall size and health.

Figure 5-4. SHRUB COUNTS (BY AGE CLASS)

Example of woody species status using a tally of individual plants, by age class, in a 6-foot wide belt along the green line. A belt 6 feet wide by 726 feet long equals 0.10 acre.



WOODY SPECIES REGENERATION SUMMARY
(R2-2200-WSSum)

Forest **WHITE RIVER NF**	District **HOLY CROSS RD**	Date Compiled **94/08/12**
Drainage **ELK CREEK**		
Examiner(s) **B. SAGE**		Photo Number(s) **4-9**
Complex		
Transect No.		

	Seedling/Sprout			Young/Sapling			Mature			Decadent			Dead			
Species	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3	Total
SAGE2	2	3	1	1			11	6	4		2		1		2	33
ALNUS	1		1		2		3	2	1	1		1		1		13
SABO2			1			2	8	2			1		1			15
TOTAL (each trans)	3	3	3	1	2	2	22	10	5	1	3	1	2	1	2	61
TOTAL (combined)		9			5			37			5			5		61

Statement of Health and General Comments:

AVERAGE HEIGHT:

Tree Layer(s)	**16 FT**
Shrub Layer(s)	**10 FT**
Herb Layer(s)	**1 FT**

GLOSSARY

— A —

ALLOTMENT

A designated area of land available for livestock grazing. Usually a grazing permit is issued designating a specified number and kind of livestock to be grazed according to directions found in an allotment management plan. It is the basic land unit used in the management of livestock on National Forest System lands and associated lands administered by the Forest Service.

ALLOTMENT MANAGEMENT PLAN (AMP)

A document that specifies the actions to be taken on individual allotments to manage and protect the rangeland resources and reach the stated set of objectives. A long-term operating plan which is the implementing document for the decision made through the National Environmental Policy Act process and promotes progress toward desired future conditions.

ALLOWABLE USE

The degree of utilization considered desirable and attainable on various specific parts of an allotment considering the present resource condition, management objectives, and management level.[1]

ANIMAL UNIT (AU)

Considered to be one mature (1,000 pound) cow or the equivalent based upon average daily forage consumption of 26 pounds dry matter per day.[2]

ANIMAL UNIT MONTH (AUM)

The amount of feed or forage required by an animal unit for one month. Not synonymous with Head Month.

APPARENT TREND

See Trend.

AQUATIC ECOSYSTEM

The stream channel, lake or estuary bed, water, biotic communities, and the habitat features that occur therein.[3]

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[1]Definition from "A Glossary of Terms Used in Range Management," Third Edition, Compiled and Edited by the Glossary Revision Committee, Publications Committee, Society for Range Management, Peter W. Jacoby, Chairman.

[2]FSH 2209.15

[3]FSM 2526.05.

— B —

BARE GROUND All land surface not covered by vegetation, rock, or litter.[4] See Ground Cover.

BENCHMARK Representative, often permanent, reference sites which reflect the results of management actions in the shortest time frames.[5]

BROWSE (n) The part(s) of shrubs, woody vines, and trees available for animal consumption. (v) To search for or consume browse.[6]

— C —

CANOPY COVER See Cover, Canopy.

CARRYING CAPACITY The average number of livestock and/or wildlife which may be sustained on a management unit compatible with management objectives for the unit. In addition to site characteristics, it is function of management goals and management intensity.[7] Synonymous with Grazing Capacity.

CLASS OF LIVESTOCK Age and/or sex group of a kind of livestock.

CLASSIFICATION The systematic arrangement of characteristics of objects into groups (taxa). The within group variation is less than the between group variation. Classification simplifies and stratifies complex systems.

CLIMAX COMMUNITY The final or stable biotic community in a developmental series. It is self perpetuating and in equilibrium with the physical habitat and environment. The presumed end point in succession.

CLOSURE, CROWN The percentage of the ground covered by a vertical projection of the outermost perimeter of the natural spread of the foliage of plants.

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[4]Definition from "New Directions in Range Condition Assessment -- Report to the Board of Directors, Society for Range Management," by the Task Group on Unity in Concepts and Terminology," North Platte, Nebraska, July 1991.
[5]FSM 1905.7.
[6]Task Group on Unity in Concepts and Terminology.
[7]Task Group on Unity in Concepts and Terminology.

COMMON LAND UNIT (CLU)
Ecological land units developed by integration of geology, landform, soil, and potential natural vegetation.

COMMON VEGETATION UNIT (CVU)
A map layer consisting of existing vegetation (both live and dead). CVUs are most often delineated as areas of vegetation possessing sufficient uniformity in regard to species, age, crown condition, structure, size, and density.

COMMON WATER UNIT (CWU)
Ecological aquatic units. Hierarchical classification of the Region's aquatic systems, including watersheds, streams, lakes, and springs. Intent is to integrate natural resources data for all aquatic systems into a geographic information system. The CWU contains four hierarchical levels: watershed, valley section, stream reach, and channel unit. Ponds, lakes, reservoirs, watershed boundaries, and double-line streams are part of, and derived from, the CWU layer.

COMMUNITY
A general term for an assemblage of plants and/or animals living together and interacting among themselves in a specific location; no particular ecological status is implied.[8]

COMMUNITY TYPE
An aggregation of all plant communities with similar structure and floristic composition. A unit of vegetation within a classification with no particular successional status implied.[9] A taxonomic unit of vegetation classification referencing existing vegetation.

COMPOSITION
See Species Composition.

CONDITION
See Rangeland Condition.

COORDINATED RESOURCE MANAGEMENT (CRM)
The process whereby various user groups are involved in discussion of alternative resource uses and collectively diagnose management problems, establish goals and objectives, and evaluate multiple use resource management.[10]

COVER, CANOPY
The percentage of ground covered by a vertical projection of the outermost perimeter of the natural spread of foliage of plants. Small openings within the canopy are included. Total canopy cover may exceed 100 percent. Synonymous with Crown Cover.[11]

COVER, CROWN
See Canopy Cover.

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[8] Task Group on Unity in Concepts and Terminology.
[9] Task Group on Unity in Concepts and Terminology.
[10] A Glossary of Terms Used in Range Management.
[11] Task Group on Unity in Concepts and Terminology.

COVER, GROUND

The percentage of material, other than bare ground, covering the soil surface. It may include organic material, such as vegetation basal cover (live and standing dead), mosses and lichens, and litter; and inorganic material, such as cobble, gravel, stones, and bedrock. Ground cover plus bare ground will total 100 percent.[12]

COVER, PERCENT

The percentage of an area covered by the combined aerial parts of plants. The percent cover may be stratified by species or by aggregations of species, either within structural layers or by aggregations of plant taxa. Total cover within any strata or combination of strata may exceed 100 percent.

COVER TYPE

A taxonomic unit of vegetation classification referencing existing vegetation. Cover type is a broad taxon based on existing plant species that dominate, usually within the tallest layer.

— D —

DENSITY

Number of individuals or stems per unit area. Density does not equate to any kind of cover measurement.[13]

DESIRED FUTURE CONDITION - RANGELANDS

The specific future condition of rangeland resources on a landscape scale which meets management objectives as identified in the Forest Plan and Allotment Management Plan. Desired future condition is based on ecological (see Desired Plant Community), social, and economic considerations during the land and resource management planning process, and includes desired outputs under a multiple use mandate. It is usually expressed in terms of ecological status or vegetation management status:

a. of vegetation; for example, species composition, habitat diversity, or age/size classes of species; and

b. of desired soil qualities; for example, conditions of soil cover, erosion, compaction, or loss of soil productivity.

In riparian areas, it includes characteristics such as conditions of stream bank and channel stability, stream habitat, stream side vegetation, stream sedimentation, or water quality.

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[12] Adapted from Task Group on Unity in Concepts and Terminology.

[13] Task Group on Unity in Concepts and Terminology.

DESIRED PLANT COMMUNITY

Of the several plant communities that may occupy a site, the one identified through a management plan that best meets the objectives for the site. It must protect the site as a minimum.[14] The desired plant community must be consistent within the capability of the area to produce vegetation through management, land treatment, or a combination of the two.

DETERIORATED RANGE

Rangeland where vegetation and soil conditions have significantly departed from the natural potential and desired resource values. Deteriorated range contains undesirable plant species and has diminished soil cover. Soil may be actively eroding or has eroded to the extent that production has fallen below acceptable minimums. Corrective management measures such as successful seeding would change the designation from deteriorated range.

DOMINANT

Plant species or species groups, which by means of their number, coverage, or size, have considerable influence or control upon the conditions of existence of associated species.[15]

— E —

ECOLOGICAL CLASSIFICATION

The process of analyzing ecological data and defining hierarchical groups (taxa) based on that data. The components of an ecological classification include: potential natural community, soil, topographic features, water, climate, and geology.[16] The purpose of ecological classification is to provide a stratification for planning, implementing, and monitoring resource management activities. Related terms include Ecological Status, Ecological Type, and Ecological Unit.

ECOLOGICAL CONDITION

See Ecological Status.

ECOLOGICAL KEYS

Tools which assist in recognizing and identifying ecological classification taxa on the ground. Keys can be developed for most ecological type components or combinations of components.

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[14] Task Group on Unity in Concepts and Terminology.

[15] Task Group on Unity in Concepts and Terminology.

[16] FSH 2090.11, Ecological Classification and Inventory Handbook.

ECOLOGICAL SITE

1. A specific location on the land that is representative of an ecological type.[17]

2. A kind of land with specific physical characteristics which differs from other kinds of land in its ability to produce distinctive kinds and amounts of vegetation and in its response to management. Synonymous with Ecological Type, as used by the Forest Service.[18]

ECOLOGICAL STATUS

The degree of similarity between the existing vegetation (all components and their characteristics) and existing soil conditions compared to the potential natural community and the desired soil condition on a site.[19] The present state of a map unit stated in terms of specific values or potentials with respect to species composition, ground cover, and soil characteristics. Ecological status is often evaluated on the basis of similarity indices between current conditions and the potential natural community.

ECOLOGICAL TYPE

1. A category of land having a unique combination of potential natural community, soil, landscape features, climate, and differing from other ecological types in its ability to produce vegetation and respond to management. Lacking potential natural community vegetation, ecological types can be developed with a provisional potential natural community based upon the present plant community and abiotic environmental factors. Categories of ecological types include all sites that have this unique combination of components with the defined ranges of properties.[20]

2. Synonymous with Ecological Site as defined by the Task Group on Unity in Concepts and Terminology.

ECOLOGICAL UNIT

A mapped landscape unit designed to meet management objectives, comprised of one or more ecological types.[21] Some ecological unit descriptions may not specifically describe all individual ecological types which compose the unit. For example, a riparian ecological unit often includes a complex of small and intricately associated riparian ecological types. The Common Land Unit (polygons, lines, or points) in the Integrated Resource Inventory is a mapping of ecological units.

[17] FSH 2090.11, Ecological Classification and Inventory Handbook.

[18] Task Group on Unity in Concepts and Terminology.

[19] FSH 2090.11, Ecological Classification and Inventory Handbook.

[20] FSH 2090.11, Ecological Classification and Inventory Handbook.

[21] FSH 2090.11, Ecological Classification and Inventory Handbook.

ECOSYSTEM

A complete interacting system of organisms and their environment.[22]

ECOSYSTEM MANAGEMENT

Ecosystem management means using an ecological approach to achieve the multiple-use management of national forests and grasslands by blending the needs of people and environmental values in such a way that national forests and grasslands represent diverse, healthy, productive, and sustainable ecosystems.

ENDANGERED SPECIES

Any species in danger of extinction throughout all or a significant portion of its range. This does not include a species of the Class Insecta determined by the Secretary to be a pest whose protection under the provisions of the Endangered Species Act would present an overwhelming and overriding risk to humans.[23]

EROSION PAVEMENT

A concentration of gravel or coarser fragments (1/8 inch to 3/4 inch) that remains on the soil surface after finer particles have been removed by running water or wind.

— F —

FORAGE

(n) Browse and herbage which is available and may provide food for grazing animals or be harvested for feeding. (v) To search for or consume forage.[24]

FORB

Any herbaceous plant other than those in the Poaceae (grass), Cyperaceae (sedge), and Juncaceae (rush) families.[25]

FREQUENCY

The ratio between the number of sample units that contain a species and the total number of sample units.[26]

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[22] FSH 2090.11, Ecological Classification and Inventory Handbook.
[23] FSM 2670.5.
[24] Task Group on Unity in Concepts and Terminology.
[25] A Glossary of Terms Used in Range Management.
[26] Task Group on Unity in Concepts and Terminology.

— G —

GRASS A member of the family Poaceae (Gramineae).[27]

GRASS-LIKE PLANT A plant of the Cyperaceae (sedge) or Juncaceae (rush) families which vegetatively resembles a true grass of the Gramineae family.[28]

GRAZING CAPACITY See Carrying Capacity.[29]

GRAZING SYSTEM A specialization of grazing management which defines systematically recurring periods of grazing and deferment for two or more pastures or management units. Descriptive names such as Hormay or Savory may be used. Common grazing systems include intermittent grazing, deferred grazing, deferred-rotation grazing, and short-duration grazing.

GREEN LINE The first perennial band of vegetation nearest the water's edge. Riparian areas that are in high seral status with stable stream banks will exhibit a continuous line of vegetation at the bankfull discharge level. Rocky stream types may have a significant amount of rock causing breaks in the vegetation; rock is considered part of the green line. Other breaks may occur in the first perennial band of vegetation. The amounts of all components should be recorded, for example, perennial vegetation, rock, bare ground, and other watercourses.

— H —

HALF-SHRUB A perennial plant with a woody base; the annually produced stems die each year.[30]

HEAD MONTH (HM) One month's use and occupancy of range by one weaned or adult animal cow, bull, steer, heifer, horse, burro, mule, or five sheep or goats.

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[27] A Glossary of Terms Used in Range Management.

[28] A Glossary of Terms Used in Range Management.

[29] Task Group on Unity in Concepts and Terminology.

[30] A Glossary of Terms Used in Range Management.

HERB

Any vascular plant except those developing persistent woody stems above ground.[31]

HERBAGE

The above-ground material of any herbaceous plant.[32]

— I —

INDICATOR SPECIES

Species which indicate certain environmental conditions, seral stages, or treatments.

INTEGRATED RESOURCE INVENTORY (IRI)

Preparation of basic resource data for entry into a Geographic Information System (GIS). The end product is reliable, integrated resource information that is consistent across the Region. Resource themes included are: Common Water Unit (CWU), Common Land Unit (CLU), and Common Vegetation Unit (CVU).

INTERDISCIPLINARY TEAM

A group of individuals from different resource backgrounds assembled to solve a problem or perform a task. The team recognizes that no one scientific discipline is sufficiently broad to adequately solve the problem. Team members proceed to a solution with frequent interaction so that each discipline may provide insights to any stage of the problem and the disciplines may combine to provide new solutions. This is different from a multi-disciplinary team where each specialist is assigned a portion of the problem and their partial solutions are linked together at the end to provide the final solution. Interdisciplinary teams are mandated by the National Environmental Policy Act (NEPA).

— K —

KEY AREA

A portion of rangeland selected because of its location, grazing or browsing value, or use. It serves as a monitoring and evaluation point for range condition, trend, or degree of grazing use. Properly selected key areas reflect the overall acceptability of current grazing management over the rangeland. A key area guides the general management of the entire area of which it is a part.[33]

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[31] Adapted from A Glossary of Terms Used in Range Management.

[32] Task Group on Unity in Concepts and Terminology.

[33] Adapted from Task Group on Unity in Concepts and Terminology.

KEY SPECIES

1. Forage species whose use serves as an indicator to the degree of use of associated species.[34] In many cases, key species include indicator species, and species traditionally referenced as increasers, decreasers, desirables, or intermediates.

2. Those species which must, because of their importance, be considered in the management program.[35]

— L —

LANDFORM

Any physical, recognizable form or feature of the earth's surface having a characteristic shape and produced by natural causes.

LITTER

Uppermost layer of organic debris on the soil surface; essentially freshly fallen or slightly decomposed vegetative material.[36]

LIVESTOCK ALLOTMENT

See Allotment.

— M —

MEASURED TREND

See Trend.

MONITORING

The orderly collection, analysis, and interpretation of resource data to evaluate progress toward meeting management objectives.[37]

— O —

OBJECTIVE

A clear, quantifiable statement of planned results to be achieved within a stated time period. An objective is achievable, quantifiable, and explicit. The completion of an objective must occur within a stated time frame and the results must be documented.

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[34] Task Group on Unity in Concepts and Terminology.

[35] Task Group on Unity in Concepts and Terminology.

[36] Task Group on Unity in Concepts and Terminology.

[37] A Glossary of Terms Used in Range Management.

OVERSTORY — The upper canopy or canopies of plants. Usually refers to trees, tall shrubs, or vines.[38]

— P —

PALATABILITY — The relative degree of attractiveness of a plant to animals as forage.

PEDESTALLED PLANTS — Plants which are growing on a hummock of soil as a result of water or wind erosion removing soil from the interspaces between plants. In some situations, this may also occur from frost heaving.

PERCENT USE — The percentage of current year's forage production that is consumed or impacted by grazing animals. May refer to a single species or to a plant community.

PHENOLOGY

1. A branch of science dealing with relations between climate and periodic biological phenomena such as flowering, germination, and growth patterns.

2. Periodic biological phenomena that are correlated with climatic conditions.

PHOTO POINT — A permanently identified point from which photographs are taken at periodic intervals. Sometimes called a camera point.[39]

PHYSIOGNOMY — Vegetation classified according to shape and structure irrespective of the species included.

PLANT ASSOCIATION — A potential natural plant community of definite floristic composition and uniform appearance,[40] represented by stands occurring in places with similar environments.[41] A taxonomic unit of vegetation classification.

PLANT COMMUNITY — An assemblage of plants living and interacting together in a specific location. No particular ecological status is implied.[42] Plant communities may include exotic or cultivated species.

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[38] A Glossary of Terms Used in Range Management.

[39] A Glossary of Terms Used in Range Management.

[40] FSH 2090.11, Ecological Classification and Inventory Handbook.

[41] Adapted from Task Group on Unity in Concepts and Terminology.

[42] FSH 2090.11, Ecological Classification and Inventory Handbook. Also adapted from Task Group on Unity in Concepts and Terminology.

PLANT COMMUNITY TYPE See Community Type.[43]

PLANT VIGOR Plant health. See Vigor.

PLOT A sampling of an ecosystem or of a site.

POINT A map feature described by a single set of coordinates.

POTENTIAL NATURAL COMMUNITY (PNC) A taxonomic unit of vegetation classification. The biotic community that would be established under present environmental conditions if all successional sequences were completed without additional human-caused disturbance. Natural disturbances, such as drought, flood, wildfire, grazing by native fauna, insect, and disease, are inherent in the development of potential natural communities which may include naturalized, non-native species.[44]

See Potential Natural Vegetation.[45]

POTENTIAL NATURAL VEGETATION (PNV) A historical term originally defined by A. W. Küchler as the stable vegetation community which could occupy a site under current climatic conditions without further influence by man. Often used interchangeably with Potential Natural Community.[46]

PROPER USE CRITERIA The limiting factor(s) which will be measured on a particular site; for example, percent forage utilization, residual forage, other resource or use impacts, or any measurable site factors.

— R —

RANGELAND All land producing, or capable of producing, native forage for grazing and browsing animals, and lands that have been revegetated naturally or artificially to provide a forage cover that is managed like native vegetation. It includes all grasslands, forblands, shrublands, and those forested lands which can -- continually or periodically, naturally or through management -- support an understory of herbaceous or shrubby vegetation that provides forage for grazing or browsing animals.

[43] Task Group on Unity in Concepts and Terminology.
[44] Adapted from FSH 2090.11, Ecological Classification and Inventory Handbook.
[45] Task Group on Unity in Concepts and Terminology.
[46] Task Group on Unity in Concepts and Terminology.

RANGELAND ANALYSIS

Systematic acquisition and evaluation of rangeland resources data needed for allotment management planning and overall land management.

RANGELAND CONDITION

1. A rangeland is considered to be in satisfactory condition when the desired future condition is being met or short-term objectives are being achieved (vegetation management status) to move the rangeland toward the desired future condition (trend). Unsatisfactory condition is when the desired future condition is not being met and short-term objectives are not being achieved (vegetation management status) to move the rangeland toward the desired future condition (trend).

2. Historically, has usually been defined in one of two ways:[47]

   a. a generic term relating to present status of a unit of range in terms of specific values or potentials. Specific values or potentials must be stated.

   b. The present state of vegetation of a range site in relation to the climax (natural potential) plant community for that site. It is an expression of the relative degree to which the kinds, proportions, and amounts of plants in a plant community resemble that of the climax plant community for the site.

RANGELAND SUITABILITY

Suitable rangeland is accessible and used by domestic livestock, has inherent forage producing capabilities, and can be grazed on a sustained yield basis under reasonable management goals. Unsuitable rangeland has no current grazing value for domestic livestock or should not be used for grazing because of physical or biological restrictions, or lacks improvements that would allow use. The identification of unsuitable range must specify the use(s) it is unsuitable for, for example, unsuitable cattle range.

RELICT (RELIC) AREA

A remnant or fragment of a flora that remains from a former period when it was more widely distributed.[48]

RESEARCH NATURAL AREA (RNA)

An area in which natural conditions are maintained insofar as possible, ordinarily by allowing natural physical and biological processes to prevail without human intervention. Under unusual circumstances, deliberate manipulation may be utilized to maintain the unique feature the RNA was established to protect.[49]

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[47] Task Group on Unity in Concepts and Terminology.
[48] A Glossary of Terms Used in Range Management.
[49] FSM 4063.05.

RESOURCE VALUE

The value of an ecosystem for a particular use or benefit on an ecological type. This value may be expressed as the actual amount or as a relative rating, when compared to the maximum value for an ecological type.[50]

RESOURCE VALUE RATING (RVR)

The value of a particular resource within a plant community for a particular use or benefit. Resource value ratings may be established for each plant community within an ecological type.[51]

RIPARIAN AREA

Geographically delineable area with distinctive resource values and characteristics that are comprised of the aquatic and riparian ecosystems.[52]

RIPARIAN COMPLEX

An ecological unit which supports or may potentially support a specified pattern of riparian ecosystems, soils, landforms, and hydrologic characteristics.

RIPARIAN ECOSYSTEM

A transition between the aquatic ecosystem and the adjacent terrestrial ecosystem; identified by soil characteristics or distinctive vegetation communities that require free or unbound water.[53] Riparian ecosystems often occupy distinctive landforms, such as flood plains or alluvial benches.

ROOTED NESTED FREQUENCY

The number of times a species occurs in a given number of plots.

— S —

SCOPING PROCESS

An early and open process for determining the scope of issues to be addressed and for identifying significant issues related to a proposed action.

SELECTIVE GRAZING

The grazing of certain plant species on the range to the exclusion of others.

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[50]FSH 2090.11, Ecological Classification and Inventory Handbook.

[51]Adapted from Task Group on Unity in Concepts and Terminology.

[52]FSM 2526.05.

[53]FSM 2526.05.

SENSITIVE SPECIES

Those plants and animal species identified by a Regional Forester for which population viability is a concern,[54] as evidenced by:

a. significant current or predicted downward trend in population numbers or density, or

b. significant current or predicted downward trend in habitat capability that will reduce a species' existing distribution.

SERAL COMMUNITY

Any community that is not at potential.[55] A relatively transitory community which develops under ecological succession, toward or away from a potential natural community.[56]

SERAL STAGE

Successional plant communities are often classified into quantitative seral stages to depict the relative position on a classical successional pathway. See Seral Community.

SERIES, PLANT

A taxonomic unit of vegetation classification which references potential vegetation. An aggregation of potential natural communities or plant associations that share the same dominant species.

SERIES, SOIL

The basic unit of soil classification being a subdivision of a family and consisting of soils which are essentially alike in all major profile characteristics except the texture of the A horizon.

SHRUB

A plant with persistent, woody stems, relatively low growth habit, and generally several basal shoots instead of a single bole. It differs from a tree by its low stature and non arborescent form.[57]

SIMILARITY

A comparison of existing vegetation and soil conditions to either potential natural community or desired plant community.

SITE

A single, specific point on the land.[58] The sample point where data measurements are taken.

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[54] FSM 2070.5.

[55] FSH 2090.11, Ecological Classification and Inventory Handbook.

[56] Adapted From Task Group on Unity in Concepts and Terminology.

[57] A Glossary of Terms Used in Range Management.

[58] FSH 2090.11, Ecological Classification and Inventory Handbook.

SITE CONSERVATION RATING (SCR)
An assessment of the protection afforded a site by the current vegetation against loss of potential. A site conservation rating greater than the site conservation threshold is considered a "satisfactory" rating and below the threshold is considered an "unsatisfactory" rating.[59]

SITE CONSERVATION THRESHOLD (SCT)
The kind, amount, and/or pattern of vegetation needed as a minimum on a given site to prevent accelerated erosion.[60]

SPECIES COMPOSITION
The proportion of plant species or aggregations of species in relation to a total area. It may be expressed in terms of canopy cover, frequency, or weight.[61]

STAND
An uninterrupted unit of vegetation, homogeneous in composition and of the same age. The vegetation can be of any physiognomic class.

SUCCESSION
The process of vegetative and ecological development whereby an area becomes successively occupied by different plant communities.

— T —

THREATENED SPECIES
Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range and that the appropriate Secretary has designated as a threatened species. (Some States also have declared certain species as threatened through their regulations or statutes.)[62]

TRANSECT
A linear plot, usually represented by a line, along which are often placed regularly spaced quadrats (plot frames), loops, or other devices.

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[59]Task Group on Unity in Concepts and Terminology.

[60]Task Group on Unity in Concepts and Terminology.

[61]Adapted from Task Group on Unity in Concepts and Terminology.

[62]FSM 2670.5.

TREND

The direction of change in an attribute as observed over time:[63]

a. Apparent trend is an interpretation of trend based on observations and professional judgment at a single point in time.[64] Trend estimates can be validated or rejected only through additional observations or measurements over time. Apparent trend is described in the same terms as measured trend. Additionally, when no trend is apparent it is described as "not apparent."

b. Measured trend is quantitative changes in vegetative or soil conditions over time, which can be measured in terms of plant communities or resource value ratings. Trend is described as "toward" or "away from" the desired plant community, or as "static." Trends for different resource values may not be consistent; it is not necessary to correlate resource value and plant community trends on the same site.

— U —

UTILIZATION

The available forage by weight consumed or trampled through livestock grazing. Usually expressed as a percent.

— V —

VEGETATION CLASSIFICATION

The process of analyzing vegetation community data and defining hierarchical entities based on that data. There are two branches of vegetation classification: potential natural and existing. The potential natural vegetation classification hierarchy includes series, subseries, plant associations, and plant association phases. The existing vegetation classification hierarchy includes cover types and community types.

VEGETATION MANAGEMENT STATUS

The relative degree to which kinds, proportions, and amounts of vegetation in the present plant community resemble the desired plant community chosen for an ecological site.[65]

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[63]Task Group on Unity in Concepts and Terminology.

[64]Task Group on Unity in Concepts and Terminology.

[65]Task Group on Unity in Concepts and Terminology.

VIGOR

The relative robustness of a plant in comparison to other individuals of the same species. It is reflected primarily by the size of a plant and its parts in relation to its age and the environment in which it is growing.[66]

[66] A Glossary of Terms Used in Range Management.